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THE PHILIPPINE
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D. GENERAL BIOLOGY, ETHNOLOGY
AND ANTHROPOLOGY

VOL. VI FEBRUARY, 1911 No. 1

# THE BURIAL MOUNDS OF CAMIGUIN ISLAND.

By MERTON L. MILLER.

*(From the Division of Ethnology, Bureau of Science, Manila, P. I.)*

The Island of Camiguin lies north of the northern end of Luzon, about 55 kilometers distant from Aparri. It is approximately 20 kilometers in extreme length and 12 kilometers in extreme width.

At the time of my arrival on the island, April 17, 1910, there was a population of 90 souls. During my stay of six weeks 30 people arrived from Dalupiri and other neighboring islands with the intention of remaining on Camiguin. Tradition says that there was formerly on the island a population of several thousand, but that the greater part of the people died of cholera between twenty and thirty years ago.

Camiguin is almost entirely covered with forests. If there formerly was a numerous population on it, the clearings which would have been made have become reforested, unless there is some open country of which I did not learn.

The people now living on the island are Ilocanos with the exception of two or three individuals who have come from the Batanes Islands. Some of the Ilocanos were born on Camiguin and some came from the Ilocos Provinces or from the Cagayan Valley. I can not say what the proportion is of native born to immigrants. All the people live within a radius of from 6 to 8 kilometers of the usual landing place at Cadadalman and all are but a short distance from the beach in the harbor of Pio Quinto. A few live at Cadadalman, more at Cadadagatan, a small

valley to the south of Cadadalman, but the majority are at Malatubat, a comparatively large valley which opens out on the other side of a rocky point, north of Cadadalman.

The extinct volcano, known to the natives as Dakelabalai, rises at the extreme southeastern point of Camiguin. There are several places with an area of from 10 to 20 hectares on the southwestern slope of this mountain where there is no vegetation and where there are many openings in the ground which emit sulphurous fumes. On these bare places and on grassy spots just beyond them are numerous artificial heaps of stones. Captain Mitchell, of the Signal Corps of the United States Army, was on Camiguin in the latter part of 1909. He was much interested in these stone piles and opened two or three of them. In the center of each he found a large earthenware jar.

My visit to Camiguin was for the purpose of discovering some clue to the people who buried these jars. The stone piles were found to be from $1\frac{1}{2}$ to 3 meters in diameter and were made up of stones ranging in size from a few centimeters to 50 centimeters in diameter. The mounds rose from 50 to 80 centimeters above the general surface of the ground.

The stones in some cases covered a mound of loose, brown earth mixed with loose stones, in others, a mixture of sulphur and clay, either in the form of a powder, or consolidated into rock, probably by the deposition of sulphur. In the center of each was an earthenware jar. The greater number of these jars were broken, usually so badly that they could not be taken out. The earth in which many of them were embedded was moist and the jars, which appeared to have been poorly baked, were in consequence easily destroyed. They hardened on drying in the air. Those which were embedded in the hardened sulphurous mass in some cases were broken, in others they could not be removed without breaking, while in a few instances it was possible to get them out. A few jars had an inner coating of very delicate crystals of sulphur.

The vessels varied in size from 20 to 60 centimeters in diameter, and in height from 20 to 80 centimeters. Some of them had mouths but little narrower than the greatest width of the jar, while others had small openings, not more than 15 centimeters in diameter. All had originally a cover of some kind over the opening, either an inverted jar or a true cover. Only in the case of one small vessel did I find the cover unbroken, so that I could determine its form. This cover was of almost the same shape as the jar below. The fragments which I found led me to infer that some of the covers had extended about halfway down the side of the body of the jar, being in reality inverted jars; others seemed to have covered the opening of the vessel and to have extended but a short distance beyond the edges.

There can be no doubt that these jars were used for containing the bones of the dead. The merest fragments of bones were found in two

of them, but they were too small to determine what bones they were; a third jar contained a small piece of one of the bones of the skull. In one of the jars were found a few common, pale blue, glass beads together with a piece of dark brown, loosely woven, coarse fabric, which fell to pieces at a touch of the hand. In another jar a few more blue beads of the same kind were seen together with a black, sticky mass which had a very unpleasant odor.

I found it almost impossible to secure any information on the island about the customs of former times, because the people native to Camiguin had all died and the few old people still living had come over from Luzon or from other islands in recent years. The only statement as to the use of these jars which I could secure was from a young man who told me that he had heard an old man say that they formerly buried the dead in earthenware vessels, cutting the legs of the corpse at the knees so as to make it possible, by doubling the legs, to put the entire body into a jar. While this may have been one practice followed, it could not have been the only method of burial, because many of the jars had openings too small to admit the body even of a young child. Of course, it is possible that two methods of burial might have been followed at the same time, one, that of putting the dead body in a jar, and the other, that of placing the bones only in the vessel after the flesh had either been removed or allowed to decay. The presence of the black, sticky mass and the beads in one jar and of the piece of fabric and beads in another would seem to argue for the first method, and the small openings in many of the jars are certainly an argument for the second method.

I made inquiries of many people as to the existence of similar heaps of stones in other parts of the island, but I could learn of none excepting a few on the other side—northeast—of the volcano from those already described. These I visited and examined. They were found to be of the same general style as those to the southwest of the volcano. I was told that at the extreme northern end of the island similar mounds were to be found. However, when I arrived there the guide pointed out certain heaps of stones which on examination proved to be natural outcrops of rock. I believe from what I learned after leaving Camiguin that possibly there are other burial mounds on the island besides those which I saw.

I do not see that there is any reason for concluding that these burials were made by any other people than Filipinos who formerly inhabited Camiguin. Cave burials have been found on at least one island off the northeast coast of Surigao, and others have recently been reported from the Island of Bohol. Burial jars containing bones have also been found in the vicinity of Dapitan, Mindanao.

However, perhaps the most interesting fact in this connection is that I was told that jars similar to these on Camiguin are to be found on Calayan, an island northwest of Camiguin. An old woman who has

lived on Camiguin for the past five years told me that formerly she lived on Calayan and that jars like those found on Camiguin were also found buried on the latter island, but she did not know what purpose they had served nor why they had been buried.

It is to be hoped that some day evidence will be found which will give a clue to the time when the dead in the Philippines were buried in jars and in caves.

# ILLUSTRATIONS.

PLATE I. Dakelabalai Mountain with burial sites in the foreground.
II. Burial mounds near sulphur fumaroles.
III. Burial mound.
IV. Burial mound.
V. Fig. 1. Partly excavated jar buried in a mixture of clay and sulphur.
2. Partly excavated jar buried in a mixture of clay and sulphur.

PLATE I.

PLATE II.

PLATE III.

PLATE IV.

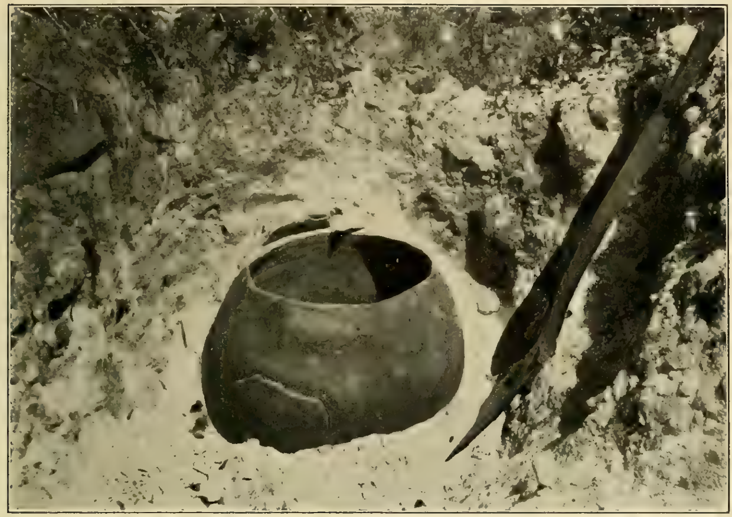

FIG. 1.

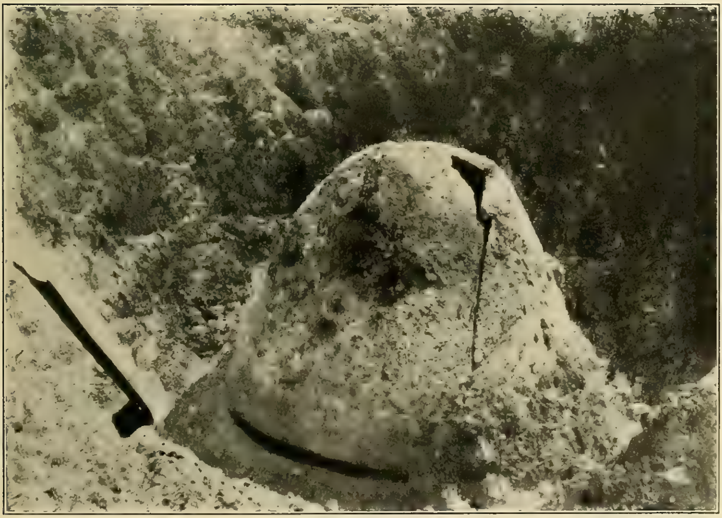

FIG. 2.

PLATE V.

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Vol. VI, No. 1, February, 1911.

# THE MEN OF CAINTA.

By ROBERT BENNETT BEAN and FEDERICO S. PLANTA.
(*From the Anatomical Laboratory, Philippine Medical School, Manila, P. I.*)

The town of Cainta, a stone's throw from Taytay near the Lake of Bay (Laguna de Bay), is of considerable historic interest because of the many bloody battles fought in its vicinity between the Spaniards and the natives, the Chinese and the natives, and the Spaniards and the Chinese. It is of great interest to the anthropologist because it presents a body of people different from the surrounding population.

Cainta was founded before the Spaniards came to the Islands, according to a statement in a history of the Philippines by Jose Montero y Vidal, who, in the first volume, page 41, affirms that Capitan Juan Salcedo, one of the first Spanish conquerors who came to the Philippines, having in 1571 subdued the natives of Cainta and Taytay first, went to the Lake (La Laguna), pacifying many towns.

There seem to be no data concerning the origin of the inhabitants of Cainta, but one of two suppositions is plausible. Either they are derived from settlers of East Indian origin who arrived before the Spaniards, or else they represent the descendants of a British regiment of East Indian troops who remained when the British evacuated the Philippines in 1763. The history of P. Murillo, written in 1752, volume 7, page 33, speaks of some of the inhabitants of the Philippines, when the Spaniards arrived, as black people, called for politeness' sake Creoles (*Criollas* or *Morenos*), who were characterized as very active politically. Murillo believed that these people came from Malabar or Coromandel, belonging to the British, and they were probably of East Indian origin.

P. Juan de Salcedo, in his history, page 264, speaking of those *Morenos* or *Criollas*, says that they have long, straight hair, long noses, and wide open eyes. He speaks further of some similar people from Malabar that he had known in Manila, who married and settled nearby in Santo Tomas and at times came to Manila on business. He also says that if they were not known as natives of the Philippines they might be regarded as Europeans, except for their dark skins.

P. Martinez asserts in his Estadimos de Filipinas, page 264, that at the beginning of the conquest of the Philippine Islands by the Spaniards there came Moors from Hindustan trading with the natives.

From these statements one may infer that the people of Cainta are of East Indian origin and occupied the town before the arrival of the Spaniards. Current opinion among Filipinos differs in regard to this, although many reliable Filipinos inform me that tradition states their

origin in a different way. A company of East Indian soldiers, stationed at Cainta during the British occupation of Manila, was overlooked when the British embarked and they settled and remained there.

It seems to me that both suppositions may be true. The town of Cainta was originally settled by East Indians, and a few men from among the British troops of East Indian origin remained when the British evacuated Manila.

The inhabitants of Cainta impressed me as being tall, black-skinned, long-nosed, and open-eyed in contrast with the inhabitants of Taytay who are small, brown-skinned, short-nosed, and not open-eyed. Some of the men I saw in Cainta were more than 180 centimeters in height, and the skin of many was of so dark a brown as to appear black. The face is large and long and the nose is notably high and long, the eyes large, with wide open lids that give the peculiarly attractive expression to the countenance which is often seen among East Indians. Whatever may have been the proximate origin of the people, I believe there can be no doubt as to their Indian origin ultimately.

In any event, they probably settled in Cainta and married Filipinos. Their descendants then resemble both Indians and Filipinos, with probably a preponderance of the former; at least such is the appearance by casual observation, and such is the actual condition as determined by measurements.

The measurements of 38 men of Cainta give average dimensions that are in almost every part slightly different from similar dimensions of the men of Taytay, and the differences are invariably in the direction of the European. The average differences are slight, as may be seen by the accompanying list, but they are significant because they are averages and because all the differences simulate the European.

TABLE I.—*Average dimensions—physical characters of adult males at Cainta, greater or less than men of Taytay.*

| Character. | Centimeters. | Character. | Centimeters. |
|---|---|---|---|
| Body: | | Head: | |
| Stature | —1.43 | Maximum length | +0.10 |
| Sitting height | —0.39 | Maximum breadth | —0.26 |
| Pubic height | —2.32 | Maximum height | +0.13 |
| Umbilical height | —1.15 | Minimal frontal breadth | —0.04 |
| Sternal height | —1.82 | Bizygomatic breadth | —0.37 |
| Chin height | —1.33 | Bimastoid breadth | —0.11 |
| Ear height | —1.00 | Bigoniac breadth | —0.19 |
| Ankle height | —0.18 | Naso-buccal distance | —0.05 |
| Knee height | —0.89 | Naso-alveolar distance | +0.03 |
| Trochanter height | —2.42 | Nose height (base) | +0.04 |
| Fingertip height | —0.26 | Nose breadth | —0.10 |
| Wrist height | —0.65 | Nose length | +0.09 |
| Elbow height | —1.71 | Chin nasion distance | +0.30 |
| Acromion height | —2.51 | Nasion hair line distance | —0.36 |

TABLE I.—*Average dimensions—physical characters of adult males at Cainta, greater or less than men of Taytay*—Continued.

| Character. | Centimeters. | Character. | Centimeters. |
|---|---|---|---|
| Head—Continued. | | Head—Continued. | |
| Mouth breadth (lips) | +0.15 | Eye length (transverse) | +0.07 |
| Mouth length | +0.10 | Frontal circumference | 0.00 |
| Ear breadth | −0.01 | Parietal circumference | −0.29 |
| Ear length | −0.05 | Forehead circumference | +0.10 |
| Ear cartilage length | +0.14 | Occipital circumference | −0.38 |
| Interocular distance | −0.08 | | |

It is to be reckoned that the indices and relative factors will also differ between the two groups of men because the actual measurements are different, and such is the case, as may be seen by the following list, all pointing to the European origin of the Cainta Indians.

TABLE II.—*Men of Cainta, indices, and relative factors, greater or less than men of Taytay.*

| Factors. | Centimeters. | Factors. | Centimeters. |
|---|---|---|---|
| Indices: | | Relative lengths: | |
| Omphalic | −2.75 | Lower leg | +0.23 |
| Nasal | −2.40 | Upper leg | +0.60 |
| Cephalic | −1.39 | Hand | +0.05 |
| Physiognomic | −0.20 | Forearm | +0.65 |
| Morphologic | +4.40 | Upper arm | −0.30 |
| Brachial | +3.80 | | |

In only one index, the brachial, does the Cainta Indian resemble other people than the European, and this index is like that of the Negro. It is also the most distinctive characteristic of the body parts of the Negro. There is then evidence of Negro mixture in the Cainta Indians, more than in the Filipinos of Taytay.

The individuals, more than the average, show distinctive European markings. One indication of European extraction for the Cainta men is the presence of a relatively large number of Iberians, more than one-third of the total number measured. The Iberians of Cainta also appear to be purer than the Iberians of other parts of the Philippines. Take for instance No. 15 with a stature of 163.6 centimeters, nasal index 77.7, cephalic index 75.9, and omphalic index 35.9, almost a typical Iberian. The face is long and narrow, the body is short, and the legs are long, all Iberian characteristics. Notice may also be taken of the three men in the plate accompanying this article, who represent Iberians of type B in figure 1, type A in figure 2, and type C in figure 3. Front and

TABLE III.—*Men*

| Type of individual. | Age. | Serial number. | Clinical number. | Body. Stature. | Sitting height. | Pubic height. | Umbilical height. | Sternal height. | Chin height. | Ear height. | Ankle height. | Knee height. | Trochanter height. | Finger tip. | Wrist height. | Elbow height. | Acromial height. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iberian | 42 | 1 | ----- | 159.0 | 85.3 | 80.0 | 91.0 | 129.8 | 137.8 | 146.8 | 7.8 | 43.5 | 81.6 | 57.5 | 73.7 | 98.8 | 128.5 |
| Alpine | 45 | 2 | 375 | 150.5 | 81.4 | 76.5 | 86.7 | 118.5 | 126.7 | 136.6 | 7.7 | 42.0 | 74.5 | 56.3 | 72.5 | 93.7 | 123.5 |
| Blend | 19 | 3 | 371 | 176.3 | 89.2 | 95.2 | 108.8 | 143.3 | 149.7 | 160.1 | 7.4 | 50.2 | 96.4 | 59.8 | 79.8 | 106.8 | 142.8 |
| Blend | 55 | 4 | 479 | 157.3 | 84.3 | 80.6 | 92.6 | 124.8 | 133.0 | 142.8 | 5.8 | 41.0 | 81.6 | 54.4 | 72.0 | 95.6 | 128.2 |
| Blend | 62 | 5 | ----- | 148.1 | 80.9 | 74.0 | 86.3 | 119.0 | 123.5 | 134.5 | 6.0 | 39.2 | 75.0 | 53.0 | 69.8 | 89.5 | 120.6 |
| Blend | 39 | 6 | ----- | 161.0 | 84.7 | 82.6 | 96.3 | 130.3 | 138.7 | 148.9 | 7.0 | 45.2 | 84.1 | 56.0 | 73.3 | 97.6 | 131.0 |
| Alpine | 28 | 7 | ----- | 161.5 | 83.0 | 83.6 | 98.5 | 131.0 | 137.0 | 147.7 | 6.5 | 44.5 | 85.0 | 56.5 | 75.0 | 100.0 | 132.5 |
| Blend | 25 | 8 | ----- | 161.0 | 80.0 | 87.5 | 105.0 | 133.0 | 138.0 | 148.0 | 6.4 | 47.0 | 88.0 | 59.8 | 77.0 | 102.0 | 135.0 |
| Blend | 29 | 9 | ----- | 160.0 | 86.0 | 81.0 | 97.0 | 130.3 | 134.5 | 145.0 | 7.0 | 45.5 | 84.5 | 55.0 | 73.0 | 99.0 | 130.0 |
| Australoid | 33 | 10 | ----- | 166.0 | 84.5 | 87.4 | 101.3 | 134.0 | 142.0 | 152.0 | 6.8 | 46.6 | 89.0 | 58.0 | 77.0 | 104.0 | 135.4 |
| Iberian | 20 | 11 | ----- | 169.4 | 85.0 | 91.0 | 104.0 | 139.0 | 145.5 | 157.0 | 7.1 | 48.7 | 90.8 | 60.6 | 79.7 | 107.5 | 140.6 |
| Blend | 15 | 12 | ----- | 154.0 | 82.0 | 98.0 | 93.0 | 126.0 | 131.0 | 139.0 | 6.3 | 42.5 | 80.0 | 58.0 | 76.0 | 98.0 | 127.0 |
| Blend | 17 | 13 | ----- | 164.0 | 86.5 | 84.5 | 97.6 | 134.0 | 141.0 | 152.0 | 7.8 | 43.7 | 85.4 | 59.0 | 75.5 | 99.0 | 135.0 |
| Blend | 25 | 14 | ----- | 169.0 | 84.3 | 89.0 | 104.0 | 140.0 | 148.0 | 156.0 | 6.8 | 47.5 | 91.0 | 60.0 | 79.0 | 107.9 | 139.9 |
| Iberian | 25 | 15 | ----- | 163.6 | 81.0 | 87.0 | 99.7 | 135.0 | 141.6 | 151.5 | 7.1 | 44.3 | 91.0 | 59.0 | 79.0 | 103.0 | 135.2 |
| Australoid | 19 | 16 | ----- | 166.0 | 86.6 | 85.0 | 100.0 | 137.0 | 144.5 | 152.8 | 7.2 | 44.0 | 87.3 | 58.8 | 75.3 | 101.0 | 136.6 |
| Blend | 30 | 17 | ----- | 167.0 | 85.0 | 88.0 | 102.5 | 137.0 | 143.3 | 153.6 | 7.5 | 45.0 | 93.0 | 61.0 | 79.5 | 106.0 | 139.4 |
| Australoid | 56 | 18 | ----- | 161.2 | 76.3 | 85.0 | 99.5 | 130.3 | 139.0 | 149.0 | 5.6 | 45.2 | 86.0 | 56.6 | 74.0 | 98.2 | 131.8 |
| Iberian | 65 | 19 | ----- | 157.0 | 81.6 | 80.8 | 92.5 | 128.2 | 134.3 | 145.2 | 6.5 | 43.6 | 83.6 | 59.0 | 76.0 | 98.6 | 131.0 |
| Blend | 30 | 20 | ----- | 158.5 | 83.2 | 78.5 | 93.3 | 128.6 | 135.7 | 145.5 | 6.4 | 45.1 | 83.7 | 54.5 | 72.2 | 94.7 | 131.0 |
| Blend | 16 | 21 | ----- | 152.5 | 76.0 | 81.0 | 92.6 | 123.0 | 128.5 | 136.5 | 6.2 | 42.5 | 82.0 | 49.5 | 68.5 | 92.0 | 124.5 |
| Australoid | 37 | 22 | ----- | 158.0 | 84.0 | 79.0 | 93.0 | 128.0 | 132.0 | 144.0 | 6.2 | 42.0 | 83.0 | 55.0 | 73.0 | 96.0 | 129.5 |
| Blend | 17 | 23 | ----- | 155.5 | 83.0 | 81.5 | 92.0 | 124.5 | 134.0 | 142.0 | 6.0 | 43.0 | 80.5 | 51.5 | 68.8 | 92.0 | 124.0 |
| Australoid | 35 | 24 | ----- | 157.0 | 83.0 | 82.0 | 95.0 | 126.0 | 135.0 | 144.0 | 4.8 | 44.0 | 82.0 | 53.0 | 73.0 | 96.0 | 128.8 |
| Blend | 60 | 25 | ----- | 160.0 | 83.0 | 84.0 | 97.0 | 129.0 | 133.0 | 145.0 | 6.8 | 46.0 | 87.0 | 62.0 | 79.0 | 102.0 | 130.0 |
| Blend | 18 | 26 | ----- | (?) | 83.0 | 77.0 | 94.5 | 126.0 | 133.0 | 142.0 | 5.8 | 40.0 | 80.5 | 56.0 | 74.0 | 97.5 | 129.0 |
| Blend | 17 | 27 | ----- | 161.0 | 81.0 | 84.0 | 96.0 | 133.0 | 137.0 | 147.0 | 6.0 | 43.0 | 86.5 | 59.4 | 77.2 | 101.3 | 133.0 |
| Australoid | 16 | 28 | ----- | 155.0 | 84.0 | 79.0 | 92.0 | 125.5 | 132.0 | 142.0 | 5.8 | 44.0 | 82.0 | 55.0 | 73.0 | 95.0 | 123.8 |
| Blend | 38 | 29 | ----- | 159.0 | 84.0 | 81.0 | 95.3 | 127.0 | 136.7 | 145.5 | 6.8 | 45.0 | 81.2 | 58.0 | 75.0 | 99.0 | 129.5 |
| Australoid | 19 | 30 | ----- | 166.5 | 87.5 | 89.0 | 104.0 | 135.6 | 142.3 | 152.6 | 6.8 | 46.5 | 90.0 | 58.0 | 76.0 | 103.5 | 138.2 |
| Blend | 34 | 31 | ----- | 151.6 | 82.0 | 79.0 | 89.0 | 124.0 | 128.0 | 140.0 | 8.7 | 42.0 | 82.0 | 55.0 | 72.7 | 95.0 | 124.5 |
| Blend | 43 | 32 | ----- | 162.0 | 86.5 | 82.5 | 95.0 | 131.0 | 141.0 | 149.3 | 6.2 | 43.6 | 86.0 | 57.5 | 75.0 | 99.0 | 131.0 |
| Blend | 26 | 33 | ----- | 163.5 | 85.5 | 86.6 | 99.5 | 133.0 | 140.6 | 151.6 | 7.2 | 47.0 | 87.6 | 57.8 | 77.0 | 102.0 | 135.5 |
| Iberian | 48 | 34 | ----- | 164.8 | 86.0 | 86.0 | 100.0 | 135.0 | 142.0 | 152.5 | 7.1 | 47.0 | 89.0 | 61.0 | 79.0 | 104.0 | 138.0 |
| Iberian | 53 | 35 | ----- | 169.0 | 85.5 | 91.0 | 101.0 | 139.5 | 144.0 | 155.8 | 8.3 | 48.5 | 94.0 | 61.5 | 81.0 | 106.5 | 140.0 |
| Australoid | 39 | 36 | ----- | 161.5 | 84.8 | 82.6 | 97.4 | 131.5 | 136.8 | 147.0 | 6.5 | 42.4 | 85.0 | 60.0 | 78.6 | 102.0 | 133.2 |
| Alpine | 47 | 37 | ----- | 159.0 | 82.7 | 86.2 | 96.0 | 129.0 | 135.5 | 146.0 | 6.8 | 48.5 | 87.0 | 56.4 | 75.0 | 101.3 | 132.0 |
| Iberian | 25 | 38 | ----- | 160.0 | 86.8 | 89.5 | 104.0 | 138.0 | 145.5 | 155.0 | 7.3 | 48.0 | 93.0 | 59.0 | 78.1 | 105.0 | 140.6 |
| General average | | | | 160.9 | 83.6 | 84.1 | 96.9 | 130.7 | 137.6 | 147.1 | 6.7 | 44.7 | 85.5 | 57.3 | 75.3 | 99.4 | 132.1 |

*of Cainta, Rizal.*

| Head. | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Maximum length. | Maximum breadth. | Maximum height. | Forehead width. | Byzygomatic. | Bimastoid. | Bigoniac. | Naso buccal. | Naso alveolar. | Nose base. | Nasion hair line. | Chin nasion. | Nose width. | Nose length. | Mouth width. | Mouth length. | Ear width. | Ear length. | Interocular distance | Eye length both eyes. | Eye color. | Frontal circumference | Parietal circumference. | Forehead circumference. | Occipital circumference. | Ear cartilage. |
| 18.0 | 14.2 | 12.5 | 10.7 | 13.0 | 12.5 | 10.6 | 7.0 | 6.3 | 3.0 | 6.3 | 11.5 | 3.6 | 4.7 | 2.2 | 5.1 | 3.4 | 5.6 | 3.0 | 6.2 | 1.5 | 30.0 | 35.0 | 26.0 | 29.6 | 4.5 |
| 17.5 | 14.8 | 12.0 | 10.4 | 13.6 | 12.3 | 10.9 | 6.9 | 6.7 | 2.7 | 6.4 | 11.5 | 3.7 | 5.1 | 1.8 | 4.9 | 3.3 | 5.6 | 3.4 | 5.7 | 2.5 | 31.8 | 34.2 | 27.7 | 27.6 | 4.5 |
| 18.4 | 14.7 | 13.2 | 10.2 | 13.6 | 13.5 | 11.0 | 7.4 | 6.5 | 3.2 | 7.0 | 12.2 | 4.2 | 5.0 | 2.6 | 4.3 | 3.8 | 6.4 | 3.4 | 6.3 | 3.0 | 32.3 | 36.2 | 27.0 | 29.5 | 5.4 |
| 18.3 | 14.9 | 12.2 | 9.9 | 14.3 | 13.0 | 11.4 | 7.7 | 6.3 | 3.1 | 7.5 | 10.7 | 3.7 | 4.8 | 1.7 | 4.7 | 3.6 | 6.4 | 3.1 | 5.9 | 2.0 | 30.4 | 34.8 | 27.8 | 28.0 | 5.5 |
| 18.1 | 15.0 | 12.8 | 10.8 | 14.2 | 13.1 | 11.0 | 7.6 | 6.5 | 3.2 | 8.5 | 11.7 | 4.5 | 5.0 | 1.0 | 5.0 | 4.0 | 7.8 | 3.3 | 6.4 | 3.0 | 30.6 | 35.8 | 28.0 | 28.7 | 5.9 |
| 18.5 | 14.6 | 12.3 | 10.8 | 13.8 | 13.3 | 10.8 | 7.4 | 7.0 | 2.7 | 6.8 | 11.8 | 4.1 | 4.8 | 1.5 | 5.1 | 3.5 | 6.0 | 3.6 | 6.5 | 3.0 | 28.8 | 35.3 | 27.8 | 28.2 | 4.6 |
| 18.2 | 15.4 | 13.3 | 10.0 | 12.8 | 12.6 | 10.4 | 7.4 | 7.2 | 3.5 | 6.0 | 12.0 | 3.5 | 5.3 | 2.5 | 4.8 | 3.7 | 5.9 | 3.1 | 6.2 | 5.0 | 31.0 | 36.5 | 27.0 | 27.0 | 5.3 |
| 18.0 | 15.2 | 11.8 | 11.5 | 14.0 | 12.8 | 11.3 | 7.2 | 6.4 | 3.0 | 7.2 | 11.2 | 4.0 | 4.6 | 2.1 | 4.6 | 3.7 | 6.9 | 3.6 | 6.4 | 2.0 | 30.8 | 35.3 | 28.4 | 27.5 | 5.3 |
| 17.8 | 14.9 | 13.0 | 10.0 | 13.0 | 12.8 | 10.2 | 7.3 | 6.8 | 2.9 | 6.0 | 12.0 | 4.1 | 5.1 | 2.3 | 5.0 | 3.6 | 6.3 | 3.0 | 6.0 | 3.0 | 31.0 | 37.0 | 26.5 | 26.5 | 5.4 |
| 19.3 | 15.0 | 12.9 | 10.7 | 14.5 | 13.0 | 11.0 | 6.8 | 6.6 | 3.0 | 7.0 | 11.2 | 4.8 | 4.7 | 2.5 | 5.4 | 3.7 | 6.7 | 3.7 | 6.4 | 4.0 | 31.7 | 36.0 | 28.8 | 28.8 | 5.4 |
| 18.6 | 14.5 | 11.7 | 10.1 | 13.6 | 13.0 | 11.3 | 6.8 | 6.5 | 3.3 | 8.0 | 11.8 | 4.0 | 4.9 | 2.1 | 5.2 | 3.8 | 6.2 | 3.2 | 6.5 | 5.0 | 29.0 | 35.0 | 26.0 | 28.5 | 5.2 |
| 17.6 | 14.2 | 12.2 | 9.6 | 12.2 | 12.0 | 10.5 | 6.5 | 5.7 | 2.2 | 5.8 | 10.5 | 3.8 | 4.2 | 2.1 | 4.8 | 3.5 | 6.2 | 3.3 | 5.9 | 3.0 | 30.0 | 34.8 | 26.2 | 27.0 | 5.1 |
| 18.2 | 14.6 | 12.5 | 10.4 | 13.2 | 12.6 | 10.5 | 6.6 | 6.1 | 3.2 | 6.0 | 11.3 | 3.8 | 4.7 | 2.3 | 5.0 | 3.3 | 5.6 | 3.1 | 5.9 | 1.0 | 30.5 | 35.8 | 28.3 | 26.4 | 4.8 |
| 17.6 | 15.4 | 12.0 | 9.7 | 12.9 | 13.4 | 10.1 | 7.2 | 6.6 | 3.1 | 7.0 | 11.0 | 4.2 | 5.0 | 2.7 | 5.3 | 3.4 | 5.6 | 3.0 | 6.0 | 3.0 | ----- | ----- | ----- | ----- | ----- |
| 18.7 | 14.2 | 12.0 | 10.2 | 12.7 | 12.2 | 9.7 | 7.1 | 6.6 | 2.8 | 7.3 | 11.5 | 3.5 | 4.5 | 1.9 | 4.5 | 3.9 | 6.0 | 3.2 | 5.7 | 3.5 | 28.5 | 35.4 | 25.7 | 29.6 | 5.4 |
| 18.7 | 14.1 | 12.3 | 10.7 | 13.9 | 12.5 | 10.2 | 6.6 | 6.1 | 2.8 | 7.7 | 11.3 | 3.8 | 4.4 | 1.8 | 4.3 | 3.9 | 6.5 | 3.5 | 6.1 | 1.0 | 29.9 | 32.5 | 28 0 | 27.8 | 5.5 |
| 18.8 | 15.1 | 13.5 | 11.1 | 14.1 | 12.6 | 10.1 | 6.7 | 5.8 | 3.5 | 6.4 | 11.0 | 4.0 | 4.5 | 2.0 | 5.1 | 3.1 | 6.0 | 3.7 | 6.1 | 3.5 | 32.5 | 37.0 | 28.5 | 25.7 | 5.1 |
| 18.3 | 13.5 | 12.5 | 10.2 | 12.8 | 12.3 | 10.4 | 7.2 | 6.3 | 3.1 | 7.7 | 11.6 | 4.4 | 4.7 | 1.6 | 4.8 | 4.0 | 6.9 | 3.2 | 6.1 | 3.0 | 30.8 | 34.2 | 27.0 | 26.4 | 5.5 |
| 18.7 | 14.4 | 12.4 | 10.0 | 13.2 | 13.3 | 10.2 | 7.9 | 7.0 | 3.6 | 7.4 | 12.1 | 4.0 | 5.4 | 1.6 | 5.5 | 3.9 | 6.6 | 2.7 | 5.9 | 3.0 | 28.6 | 35.0 | 26.2 | 28.0 | 5.6 |
| 18.5 | 15.0 | 13.4 | 10.4 | 14.0 | ----- | 10.4 | 6.9 | 6.2 | 3.0 | 6.5 | 12.0 | 4.0 | 5.1 | 1.8 | 4.7 | 3.3 | 5.5 | 3.6 | 6.1 | 1.0 | 31.0 | 35.0 | 28.5 | 28.5 | 4.6 |
| 18.2 | 14.5 | 12.6 | 10.4 | 13.1 | 13.0 | 10.3 | 7.0 | 6.4 | 2.7 | 7.2 | 10.6 | 3.8 | 4.3 | 2.5 | 4.5 | 3.5 | 6.6 | 3.3 | 5.8 | 3.5 | 29.0 | 36.4 | 26.3 | 29.0 | 5.0 |
| 20.0 | 15.0 | 13.1 | 11.3 | 14.4 | 13.1 | 11.1 | 7.4 | 6.8 | 3.1 | 7.4 | 12.1 | 4.1 | 4.5 | 3.0 | 5.4 | 3.6 | 6.0 | 3.4 | 6.7 | ---- | 33.0 | 37.5 | 29.5 | 29.5 | 4.6 |
| 17.8 | 14.8 | 12.5 | 10.6 | 13.1 | 12.3 | 10.3 | 6.6 | 6.1 | 3.0 | 7.1 | 10.8 | 4.1 | 4.4 | 2.0 | 4.7 | 3.4 | 5.7 | 3.6 | 5.4 | 1.0 | 30.6 | 35.5 | 27.3 | 27.3 | 5.1 |
| 18.7 | 15.1 | 12.8 | 10.5 | 14.0 | 15.6 | 10.5 | 7.1 | 6.4 | 3.0 | 7.4 | 10.7 | 3.7 | 4.0 | 1.6 | 5.2 | 3.8 | 6.6 | 3.4 | 5.7 | 3.5 | 31.0 | 36.6 | 27.6 | 28.7 | 5.2 |
| 19.0 | 15.4 | 13.0 | 10.8 | 14.2 | 13.0 | 11.0 | 8.3 | 7.6 | 3 1 | 9.0 | 13.2 | 4.3 | 5.6 | 1.3 | 4.8 | 3.7 | 6.5 | 3.5 | 6.2 | 4.0 | 32.0 | 36.6 | 29.5 | 28 0 | 5.3 |
| 18.0 | 14.4 | 12.3 | 10.5 | 12.9 | 12.4 | 10.0 | 7.1 | 6.5 | 3.2 | 6.3 | 11.6 | 3.5 | 4.9 | 1.8 | 4.2 | 3.3 | 5.5 | 3.0 | 6.3 | 2.0 | 28.8 | 36.6 | 26.0 | 29.0 | 4.4 |
| 18.2 | 14.4 | 12.5 | 10.3 | 12.5 | 12.0 | 9.8 | 6.8 | 6.2 | 2.7 | 6.8 | 10.6 | 4.0 | 4.8 | 1.8 | 4.5 | 3.2 | 6.0 | 3.6 | 5.7 | 3.0 | 29.0 | 35.6 | 27.0 | 27.8 | 4.8 |
| 18.3 | 14.8 | 13.0 | 10.7 | 13.8 | 13.0 | 10.3 | 6.6 | 6.5 | 2.7 | 7.8 | 10.0 | 4.1 | 4.4 | 2.5 | 4.1 | 3.4 | 6.2 | 3.4 | 6.3 | 2.5 | 31.7 | 34.8 | 28.0 | 26.6 | 5.0 |
| 18.3 | 16.0 | 12.5 | 10.5 | 13.6 | 12.7 | 10.3 | 7.0 | 6.4 | 2.6 | 6.6 | 11.1 | 3.7 | 4.5 | 2.0 | 5.1 | 3.4 | 5.4 | 3.1 | 6.1 | ---- | ----- | ----- | ----- | ----- | 4.3 |
| 18.7 | 15.0 | 12.6 | 10.8 | 13.8 | 13.7 | 11.2 | 6.7 | 6.3 | 2.7 | 5.7 | 11.6 | 4.1 | 4.0 | 2.3 | 5.2 | 3.1 | 6.4 | 3.8 | 6.0 | ---- | 30.7 | 36.0 | 28.2 | 29.6 | 5.8 |
| 18.5 | 15.1 | 12.7 | 11.2 | 14.0 | 12.4 | 11.0 | 7.2 | 6.0 | 2.7 | 7.3 | 11.7 | 4.2 | 5.0 | 2.2 | 5.2 | 3.8 | 6.2 | 3.5 | 5.0 | ---- | 32.0 | 35.0 | 28.2 | 30.0 | 5.0 |
| 19.1 | 15.5 | 12.7 | 10.7 | 14.4 | 14.0 | 11.0 | 7.7 | 7.1 | 3.2 | 8.1 | 13.0 | 3.8 | 5.1 | 2.1 | 5.0 | 3.1 | 5.8 | 3.2 | 6.5 | ---- | 31.0 | 36.0 | 29.0 | 31.0 | 4.8 |
| 17.8 | 14.7 | 12.5 | 10.4 | 13.6 | 12.3 | 11.0 | 7.6 | 6.9 | 3.0 | 6.3 | 12.0 | 4.0 | 5.0 | 2.7 | 5.4 | 3.8 | 5.8 | 3.4 | 6.3 | ---- | 30.2 | 31.8 | 28.2 | 26.2 | 5.1 |
| 19.6 | 14.7 | 12.5 | 10.2 | 13 1 | 12.8 | 10.0 | 7.5 | 6.9 | 3.3 | 6.2 | 12.0 | 3.5 | 5.3 | 1.4 | 5.2 | 3.7 | 6.7 | 3.2 | 6.4 | ---- | 31.0 | 34.8 | 23.6 | 29.6 | 5.6 |
| 18.6 | 14.7 | 12.6 | 10.2 | 13.4 | 12.7 | 10.7 | 8.4 | 7.2 | 3.3 | 7.5 | 12.3 | 4.2 | 5.4 | 2.4 | 5.2 | 3.7 | 6.4 | 3.4 | 6.3 | ---- | 30.4 | 34.3 | 28.0 | 28.2 | 5.3 |
| 20.0 | 15.0 | 13.6 | 10.5 | 13.6 | 12.5 | 10.0 | 7.2 | 6.6 | 3.1 | 6.8 | 11.6 | 4.0 | 4.7 | 2.5 | 5.0 | 4.0 | 6.3 | 3.3 | 6.4 | ---- | ----- | ----- | ----- | ----- | 5.0 |
| 17.2 | 15.5 | 12.3 | 9.6 | 13.0 | 12.4 | 10.5 | 7.4 | 6.5 | 2.5 | 5.4 | 12.0 | 3.8 | 5.3 | 1.7 | 4.7 | 3.5 | 5.6 | 3.3 | 5.7 | ---- | ----- | ----- | ----- | ---- | 5.7 |
| 18.2 | 14.3 | 12.8 | 10.3 | 12.7 | 13.0 | 10.0 | 7.5 | 6.7 | 3.0 | 7.0 | 11.9 | 3.8 | 5.1 | 2.0 | 4.8 | 3.6 | 6.0 | 3.6 | 6.4 | ---- | ----- | ----- | ----- | ----- | 5.2 |
| 18.4 | 14.7 | 12.6 | 10.4 | 13.4 | 12.8 | 10.5 | 7.1 | 6.5 | 2.9 | 6.9 | 11.5 | 3.9 | 4.8 | 2.05 | 4.9 | 3.5 | 6.1 | 3.3 | 6.09 | ---- | 30.5 | 35.4 | 27.6 | 28.1 | 5.1 |

TABLE IV.—*Men of Cainta,*

| Species. | Number. | Absolute lower leg length. | Relative lower leg length. | Absolute upper leg length. | Relative upper leg length. | Absolute hand length. | Relative hand length. | Absolute fore-arm length. | Relative fore-arm length. | Absolute upper arm length. | Relative upper arm length. | Pubis to umbilicus. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Iberian | 1 | 37.7 | 23.7 | 36.1 | 22.7 | 16.2 | 10.1 | 25.1 | 15.7 | 29.7 | 18.6 | 11.0 |
| Iberian | 2 | 34.3 | 22.7 | 32.5 | 21.5 | 16.2 | 10.7 | 21.2 | 14.0 | 29.8 | 19.8 | 10.2 |
| Blend | 3 | 42.8 | 24.2 | 46.2 | 26.2 | 20.0 | 11.3 | 27.0 | 15.3 | 36.0 | 20.4 | 13.6 |
| Iberian | 4 | 35.2 | 22.3 | 40.6 | 25.8 | 17.6 | 11.1 | 23.6 | 15.0 | 32.6 | 20.7 | 12.0 |
| Blend | 5 | 33.2 | 22.4 | 35.8 | 24.1 | 16.8 | 11.3 | 19.7 | 13.3 | 31.1 | 20.9 | 12.3 |
| Iberian | 6 | 38.2 | 23.7 | 38.9 | 24.1 | 17.3 | 10.7 | 24.3 | 15.0 | 33.4 | 20.7 | 13.7 |
| Iberian | 7 | 38.0 | 23.5 | 40.5 | 25.0 | 18.5 | 11.4 | 25.0 | 15.4 | 32.5 | 20.1 | 14.9 |
| Blend | 8 | 40.6 | 25.2 | 41.0 | 25.4 | 17.2 | 10.6 | 25.0 | 15.5 | 33.0 | 20.4 | 17.5 |
| Blend | 9 | 38.2 | 23.8 | 39.3 | 24.5 | 18.0 | 11.2 | 26.0 | 16.2 | 31.0 | 19.3 | 16.0 |
| Australoid | 10 | 39.8 | 23.9 | 42.4 | 25.5 | 19.0 | 11.4 | 27.0 | 16.2 | 31.4 | 18.9 | 13.9 |
| Iberian | 11 | 41.6 | 24.5 | 42.1 | 24.8 | 19.1 | 11.2 | 27.8 | 16.4 | 33.1 | 19.5 | 13.0 |
| Blend | 12 | 36.2 | 23.5 | 37.5 | 24.3 | 18.0 | 11.6 | 22.0 | 14.2 | 29.0 | 18.8 | (?) |
| Blend | 13 | 35.9 | 21.8 | 41.7 | 25.4 | 16.5 | 10.0 | 23.5 | 14.3 | 36.0 | 21.9 | 13.1 |
| Blend | 14 | 40.7 | 24.0 | 43.5 | 25.7 | 19.0 | 11.5 | 28.0 | 16.5 | 32.9 | 19.4 | 15.0 |
| Iberian | 15 | 37.2 | 22.7 | 46.7 | 28.5 | 20.0 | 12.2 | 24.0 | 14.6 | 32.2 | 19.6 | 12.7 |
| Australoid | 16 | 36.8 | 22.1 | 43.3 | 26.0 | 16.5 | 9.9 | 25.7 | 15.4 | 35.6 | 21.4 | 15.0 |
| Blend | 17 | 37.5 | 22.4 | 48.0 | 28.7 | 18.5 | 11.0 | 26.5 | 15.8 | 33.4 | 20.0 | 14.5 |
| Iberian | 18 | 39.6 | 24.5 | 40.8 | 25.3 | 17.4 | 10.7 | 24.2 | 15.0 | 33.6 | 20.8 | 14.5 |
| Iberian | 19 | 37.1 | 23.6 | 40.0 | 25.4 | 17.0 | 10.8 | 22.6 | 14.3 | 32.4 | 20.6 | 11.7 |
| Iberian | 20 | 38.7 | 24.4 | 38.6 | 24.3 | 17.7 | 11.1 | 22.5 | 14.1 | 36.3 | 22.2 | 14.8 |
| Blend | 21 | 36.3 | 23.8 | 39.5 | 25.8 | 19.0 | 12.4 | 23.5 | 15.4 | 32.5 | 21.3 | 11.6 |
| Australoid | 22 | 35.8 | 22.6 | 41.0 | 25.9 | 18.0 | 11.3 | 23.0 | 14.5 | 33.5 | 21.2 | 14.0 |
| Blend | 23 | 37.0 | 23.7 | 37.5 | 24.1 | 16.5 | 10.6 | 24.0 | 15.4 | 32.0 | 20.5 | 10.5 |
| Australoid | 24 | 39.2 | 24.9 | 38.0 | 24.2 | 20.0 | 12.7 | 23.0 | 14.6 | 32.8 | 20.8 | 13.0 |
| Blend | 25 | 39.2 | 24.5 | 41.0 | 25.6 | 17.0 | 10.6 | 23.0 | 14.3 | 28.0 | 17.5 | 13.0 |
| Blend | 26 | 34.2 | ------ | 40.5 | ------ | 18.0 | ------ | 23.0 | ------ | 32.0 | ------ | 17.5 |
| Blend | 27 | 37.0 | 22.9 | 43.5 | 27.0 | 17.8 | 11.0 | 24.1 | 14.9 | 31.7 | 19.6 | 12.0 |
| Australoid | 28 | 38.2 | 24.6 | 38.0 | 24.5 | 18.0 | 11.6 | 22.0 | 14.1 | 28.8 | 18.5 | 13.0 |
| Blend | 29 | 38.2 | 24.0 | 36.2 | 22.7 | 17.0 | 10.6 | 24.0 | 15.0 | 30.5 | 19.1 | 14.3 |
| Australoid | 30 | 39.7 | 23.8 | 43.5 | 26.1 | 18.0 | 10.8 | 27.5 | 16.5 | 34.7 | 20.8 | 15.0 |
| Blend | 31 | 33.3 | 21.9 | 40.0 | 26.3 | 17.7 | 11.6 | 22.3 | 14.6 | 29.5 | 19.4 | 10.0 |
| Iberian | 32 | 37.4 | 23.0 | 42.4 | 26.1 | 17.5 | 10.8 | 24.0 | 14.8 | 32.0 | 19.7 | 12.5 |
| Iberian | 33 | 39.8 | 24.3 | 40.6 | 24.8 | 19.2 | 11.7 | 25.0 | 15.2 | 33.5 | 20.5 | 12.9 |
| Iberian | 34 | 39.9 | 24.2 | 42.0 | 25.4 | 18.0 | 10.9 | 25.0 | 15.1 | 34.0 | 20.6 | 14.0 |
| Iberian | 35 | 40.2 | 23.7 | 45.5 | 26.9 | 19.5 | 11.5 | 25.5 | 15.0 | 33.5 | 19.8 | 10.0 |
| Australoid | 36 | 35.9 | 22.2 | 42.6 | 26.3 | 18.6 | 11.5 | 23.4 | 14.4 | 31.2 | 19.3 | 14.8 |
| Alpine | 37 | 41.7 | 26.2 | 38.5 | 24.2 | 18.6 | 11.7 | 26.3 | 16.5 | 30.7 | 19.3 | 9.8 |
| Iberian | 38 | 40.7 | 24.0 | 45.0 | 26.6 | 19.1 | 11.3 | 26.9 | 15.9 | 35.6 | 21.0 | 14.5 |
| General average |  | 37.9 | 23.6 | 40.78 | 25.2 | 18.0 | 11.1 | 24.3 | 15.1 | 32.4 | 20.0+ | 13.2+ |

*indices and relative factors.*

| Umbilicus to sternum. | Omphalic index. | Total head heigth. | Upper face heigth. | Cephalic index. | Nasal index. | Ear type. | Morphologic face index. | Physiognomic face index. |
|---|---|---|---|---|---|---|---|---|
| 38.8 | 28.3 | 21.2 | 9.7 | 78.8 | 76.6 | Iberian | 88.4 | 73.0 |
| 31.8 | 32.0 | 23.8 | 12.3 | 84.6 | 72.6 | Iberian | 84.5 | 75.9 |
| 34.5 | 39.4 | 26.6 | 14.4 | 79.9 | 84.0 | Mixed Primitive | 89.7 | 70.8 |
| 32.2 | 37.2 | 24.8 | 13.6 | 81.4 | 77.1 | Iberian C and D | 75.5 | 78.5 |
| 32.7 | 37.6 | 24.6 | 12.9 | 82,9 | 90.0 | B. B. B. Iberian C | 82.3 | 70.2 |
| 34.0 | 40.3 | 22.3 | 10.5 | 78.9 | 85.4 | Iberian A and D | 85.5 | 74.1 |
| 32.5 | 45.8 | 24.5 | 12.5 | 84.6 | 66.0 | Iberian A | 93.7 | 71.1 |
| 28.0 | 62.5 | 23.0 | 11.8 | 84.4 | 86.9 | Mixed Primitive | 80.0 | 76.0 |
| 33.3 | 48.4 | 25.5 | 13.5 | 83.7 | 81.9 | Mixed Iberian B and D | 94.6 | 72.2 |
| 32.7 | 42.5 | 24.0 | 12.8 | 77.7 | 102.1 | Mixed B. B. B., Primitive | 77.2 | 79.6 |
| 35.0 | 37.1 | 23.9 | 12.1 | 77.9 | 81.6 | Mixed | 86.7 | 68.6 |
| 33.0 | ------ | 23.0 | 12.5 | 80.6 | 90.4 | Mixed | 86.0 | 74.8 |
| 36.4 | 35.9 | 23.0 | 11.7 | 80.2 | 80.8 | Iberian A Primitive | 85.6 | 76.3 |
| 36.0 | 41.6 | 21.0 | 10.0 | 87.5 | 84.0 | Iberian B Primitive | 85.2 | 71.6 |
| 35.3 | 35.9 | 22.0 | 10.5 | 75.9 | 77.7 | Primitive | 90.5 | 67.5 |
| 37.0 | 40.5 | 21.5 | 10.2 | 75.4 | 86.3 | Iberian D, Mixed Alpine Primitive | 81.3 | 73.1 |
| 34.5 | 42.0 | 23.7 | 12.7 | 80.3 | 88.8 | Iberian A Primitive | 78.0 | 81.0 |
| 30.8 | 47.0 | 22.2 | 10.6 | 73.8 | 93.6 | Iberian C | 90.6 | 66.3 |
| 35.7 | 32.7 | 22.7 | 10.6 | 77.0 | 74.6 | Iberian A and C | 91.6 | 67.7 |
| 35.3 | 41.9 | 22.8 | 10.8 | 81.0 | 78.4 | Iberian, Mixed | 85.7 | 75.6 |
| 30.4 | 38.1 | 24.0 | 13.4 | 79.7 | 88.4 | Mixed Iberian D subnorthern | 80.9 | 73.6 |
| 35.0 | 40.0 | 26.0 | 13.9 | 75.0 | 91.1 | Iberian, mixed | 84.0 | 73.8 |
| 32.5 | 32.3 | 21.5 | 10.7 | 84.4 | 93.2 | Mixed Iberian, Primitive | 82.4 | 73.1 |
| 31.0 | 41.9 | 22.0 | 11.3 | 80.7 | 95.2 | Iberian A, mixed | 76.4 | 77.3 |
| 32.0 | 40.6 | 27.0 | 13.8 | 81.1 | 76.7 | Iberian D, B. B. B. | 92.9 | 63.9 |
| 31.5 | 55.5 | ------ | ------ | 80.0 | 71.4 | Mixed Primitive, Iberian | 88.1 | 72.0 |
| 37.0 | 32.4 | 24.0 | 13.4 | 79.1 | 83.3 | Mixed Primitive subnorthern | 84.8 | 71.8 |
| 33.5 | 38.8 | 23.0 | 13.0 | 80.9 | 93.2 | Mixed Alpine Primitive | 72.4 | 76.9 |
| 31.7 | 45.1 | 22.3 | 11.2 | 87.4 | 82.2 | Odd type, Alpine, Primitive | 81.6 | 76.8 |
| 31.6 | 47.4 | 13.9 | (?) | 80.2 | 102.5 | Mixed subnorthern | 84.0 | 79.7 |
| 35.0 | 28.5 | 23.6 | 11.9 | 81.6 | 84.0 | Mixed B. B. B., Primitive Iberian | 83.5 | 73.6 |
| 36.0 | 34.7 | 21.0 | 8.0 | 81.2 | 74.5 | Iberian D, mixed | 90.2 | 68.2 |
| 33.5 | 38.5 | 23.0 | 11.5 | 82.6 | 80.0 | Iberian D and C | 88.2 | 74.3 |
| 35.0 | 40.0 | 22.8 | 10.8 | 75.0 | 66.0 | Mixed Iberian A and D | 91.5 | 71.9 |
| 38.5 | 25.9 | 25.0 | 12.7 | 79.0 | 77.7 | Iberian A and D | 91.7 | 67.6 |
| 34.1 | 43.4 | 24.7 | 13.1 | 75.0 | 85.1 | Mixed B. B. B., Primitive | 85.3 | 73.9 |
| 33.6 | 29.1 | 23.5 | 11.5 | 90.1 | 71.7 | Iberian, mixed | 92.3 | 74.7 |
| 34.0 | 42.6 | 23.5 | 11.6 | 78.6 | 74.5 | Iberian A, B, D. | 93.7 | 67.2 |
| 33.8 | 39.5 | 23.4 | 11.8 | 80.4 | 82.8 | | 85.7 | 73.0 |

side bust views of these men have been published already with the men of Taytay [1] to illustrate the Iberian type.

Absence of the Primitive is noteworthy at Cainta, and there is no modified Primitive or any form resembling them except the Blend. A few Australoid and Alpine types are seen and these with the Blends indicate to some extent the Filipino mixture.

Enough has been given to demonstrate the similarity of the Cainta men to the European, and to the East Indian. Their presence proves that such people came to the Philippines, and the presence of similar types throughout the Islands indicates an Indian influence. This has been no inconsiderable factor in the peopling of the Philippines and explains the great prevalence of the Iberian throughout the archipelago. In support of this view, the recent work of Saleeby [2] concerning the Hindu influence previous to the more recent Spanish occupation and before the Moro or Mohammedan invasion of the Islands, is worth noting.

[1] *This Journal, Sec. A.* (1909), 4, 359.

[2] Studies in Moro History, Law and Religion. *Ethnolog. Surv. Pub.* Manila (1905), 4, Part I.

## ILLUSTRATIONS.

PLATE I. East Indians of Cainta.

FIG. 1. (38) Iberian Type C.
2. (14) Iberian Type A.
3. (18) Iberian Type D.

FIG. 1 (No. 38).

FIG. 2 (No. 19).

FIG. 3 (No. 18).

PLATE I.

The Philippine Journal of Science,
D. General Biology, Ethnology and Anthropology.
Vol. VI, No. 1, February, 1911.

# BORKENKÄFER DER PHILIPPINEN.

Von H. Strohmeyer.
(*Münster Ober-Elsass, Germany.*)

## ERSTE SERIE.

Über die Borkenkäfer-Fauna der Philippinen ist bisher sehr wenig bekannt geworden. Eichhoff beschreibt in seiner Monographie zwei dortige Arten respective eine davon Varietät: *Xyleborus kraatzii* var. *philippinensis*,[1] und *Coccotrypes pygmæus*[2] Eichh. Eine weitere von den Philippinen bekannte Art ist: *Xyleborus capito* Schauf.[3] Hagedorn erwähnt das Vorkommen von *Eurydactylus sexspinosus* Motsch. auf Luzon.[4] Fast ebenso unbedeutend wie die Zahl der von den Philippinen bekannten Ipiden (Scolytiden) ist diejenige der Platypodiden. Chapuis nennt nur vier Arten:[5] *Crossotarsus lecontei* Chap., *Platypus setaceus* Chap., *Pl. turbatus* Chap. und *Pl. lepidus* Chap. Eine fünfte Art: *Pl. philippinensis*[6] fügte später Blandford hinzu.

Auf Grund des Studiums der Borkenkäfer aus der staatlichen Sammlung in Manila bin ich in der Lage weitere Beiträge zur Kenntnis dieser forst- und landwirtschaftlich schädlichen Insekten zu liefern und zwar nicht nur auf rein systematischem, sondern auch auf biologischem Gebiete.

Unter den nachfolgend aufgeführten zwölf Borkenkäferarten sind zehn neu für diese Inselgruppe, fünf hiervon waren bisher überhaupt noch nicht beschrieben.

[1] Eichhoff, Ratio, descriptio, emendatio Tomicinorum (1878), 374.
[2] *Loc. cit.* (1879), 310.
[3] Schaufuss, *Tijdschr. voor Ent.* (1897), **40**, 215.
[4] *Deutsche Ent. Ztschr.* (1908), 377.
[5] Chapuis, Monographie des Platypides (1868).
[6] *Trans. Ent. Soc. London* (1896), 193.

# IPIDÆ (Scolytidæ).

## I. PILIDENTATÆ.[7]

### PHLŒOTRUPINÆ.

#### DACTYLIPALPUS Chapuis.

**Dactylipalpus transversus** Chapuis.

*Dactylipalpus quadratocollis* Chapuis, Synops. des Scolyt., Mem. Soc. Roy. Sci. Liége (1869), 12; Strohmeyer, Entomol. Blätter (1909), Heft. 12.

MINDORO, Rio Baco, P. I. (3388, *R. C. McGregor*).

Diese Art war bisher nur bekannt von Malacca, Ternate, Celebes und Sumatra. *D. quadratocollis* Chap. ziehe ich als Synonym zu *D. transversus* nachdem ich durch Untersuchung der Geschlechtsorgane auch bei afrikanischen *Dactylipalpus*-Arten festgestellt habe, das der Quereindruck auf dem Halsschilde ein s. g. sekundärer Geschlechtscharakter des Weibchens und kein Artkennzeichen ist. Die weiteren von Chapuis bei *quadratocollis* genannten Unterscheidungsmerkmale; geringere Grösse und mehr quadratisches Halsschild sind nur Eigentümlichkeiten der schmäleren und meist kleineren Männchen.[8]

## II. SPINIDENTATÆ.[7]

### HYLESINIDÆ.

#### SPHÆROTRYPES Blandford.

**Sphærotrypes philippinensis** sp. nov.

Brevissime ovatus, piceus vel nigropiceus, antennis tarsisque dilutioribus rufescentibus; capite nigropiceo, vertice in fundo subtilissime reticulato haud dense sed fortiter punctato; fronte plana rugose punctata, squamulis flavis ac pilis parvis sat dense adspersa, supra os plerunque carinula longitudinali brevi laevi; prothorace sat nitido valde transverso, anterius fortiter angustato, basi postice acutius producta, ad latera evidenter marginato, post apicem constricto, in fundo subtilissime reticulato haud dense punctato punctis magnis squamiferis irregulariter dispositis, praesertim antice brevissime tomentoso et pilis singulis flavis adsperso, linea mediana plus minusve obsoleta; elytris prothorace latio-

[7] Haged., *Ent. Blätter* (1909), 5, 163.

[8] Zu vergl. meine Arbeit in den Entomologischen Blättern, Jahrg. 1909, Heft 12: "Beschreibung zweier neuer *Phlœoborus*-Arten und Ergänzung der Diagnosen einiger bekannter Phlœotrupiden unter Berücksichtigung der sekundären Geschlechtscharaktere."

ribus, striato-punctatis, punctis rotundis distantibus, striis basin versus angustatis et ante marginem anteriorem abbreviatis, interstitiis striis multo latioribus elevatis, ante marginem basalem valde dilatatis, et transverse rugosis, fortiter et irregulariter punctatis punctis squamiferis, praesertim in disco tuberculis majoribus uniseriatim dispositis et antice in carinulam plus minusve confluentibus; abdomine subtus fortiter ac dense punctato.

Longitudo 3.2–3.5 mm.; latitudo prothoracis 1.9–2.1 mm.; latitudo elytrorum 2.1–2.3 mm.

MINDANAO, Zamboanga, P. I. (*W. I. Hutchinson* legit).

Futterpflanze: Yacal (*Hopea*).

1 Type No. 8849 in der Entomologischen Sammlung des Bureau of Science, Manila, P. I.

1 Paratype in meiner Sammlung.

Kurz eiförmig, heller oder dunkler pechbraun mit etwas helleren mehr rötlich-braunen Antennen und Tarsen; Kopf dunkel pechfarben, Scheitel auf chagriniertem Grunde kräftig aber nicht sehr dicht punktiert; Stirn flach, grob punktiert, ziemlich dicht mit gelblichen Schuppen und kleinen Haaren besetzt, über den Mundteilen mit einem zuweilen fehlenden kurzen und glattem Längskiele; Prothorax mässig glänzend, breiter als lang, nach vorn stark verschmälert und vor der Spitze eingeschnürt, an der Basis hinten in der Mitte mit vorgezogener Spitze, an den Seiten deutlich gerandet auf fein chagriniertem Grunde ungleich und mässig dicht punktiert, die schuppentragenden Punkte gross und nur flach eingedrückt, besonders der vordere Teil des Halsschildes oben kurz und dicht behaart mit einzelnen zwischenstehenden längeren Borsten, die Mittellinie ziemlich undeutlich und bei den einzelnen Exemplaren ungleich ausgebildet; Flügeldecken etwas breiter als das Halsschild, in deutlich ausgeprägten Streifen punktiert, die Punktstreifen vor der etwas wulstigen Basis sehr verschmälert und abgekürzt, die Zwischenräume zwischen den Streifen breiter als die Punktstreifen, vor der Basis mehr oder weniger miteinander verschmelzend, gewölbt und unregelmässig punktiert mit schuppentragenden Punkten, hauptsächlich auf der Scheibe mit je einer Reihe weitläufig gestellter Tuberkeln welche nach der Basis hin mehr oder weniger zu einer Leiste zusammenfliessen, die verbreiterten Teile der Zwischenräume an der Basis quer gerunzelt; Abdomen auf der Unterseite stark und dicht punktiert.

In Fig. 1 und 2 sind Mentum und Maxillen abgebildet.

Von *Sphærotrypes siwalikensis* Stebbing unterscheidet sich diesse Art unter Anderem durch das Fehlen des hinteren Quereindruckes auf dem Halsschilde, von *Sph. coimbatorensis* Stebbing durch die Sculptur des Prothorax und von *Sph. pila* und *globulus* Blandford durch die Beschaffenheit der Flügeldecken. Das glattere und nur mässig dicht punktierte

Halsschild schliesst auch eine Verwechslung dieser Art mit *Sphærotrypes tanganus* Schaufuss, *blandfordi* Schaufuss und *barbatus* Hagedorn aus.

Fig. 1. Fig. 2.

FIGS. 1 und 2.—*Sphærotrypes philippinensis* Strohmeyer. Mentum, palpi labiales et maxillæ. 80 × vergrössert.

Gefangen wurden die mir vorliegenden Exemplare von *Sphærotrypes philippinensis* m. an Yakal, einem Hartholze der Gattung *Hopea*.

Die Frassfigur (Tafel I) besteht aus einem einarmigen Lotgange ohne Rammelkammer (nuptial chamber) und zahlreichen sich nicht kreuzenden Larvengängen. Der Muttergang, welcher meist oben an der Spitze mehr oder weniger nach einer Seite gekrümmt ist, hat eine Länge von 3.5 bis 4.5 cm.[9] Die Eigruben, in welche die Eier einzeln abgeleg werden, sind äusserst dicht aneinander gereiht. Die verhältnismässig kurzen und breiten Larvengänge fallen dadurch auf, dass sie sehr früh an Breite zunehmen, eine Tatsache, die auf ein sehr rasches Wachstum deutet. Die Puppenwiegen liegen am Ende der Larvengänge, welche in Splint und Rinde ungefähr gleich tief einschneiden.

Nach Stebbings Abbildung zu urteilen sind die Muttergänge von *Sphærotrypes siwalikensis* Stebbing[10] kürzer und die Eigruben weniger dicht aneinander gedrängt. Letztgenannter Käfer lebt an *Shorea robusta*.

## CRYPHALINÆ.

### CRYPHALUS Erichson.

**Cryphalus squamulosus** sp. nov.

Elongatus, fere cylindricus, pallide flavescens, prothorace anteriori et capite rufescentibus; oculis reniformibus antice emarginatis; vertice subtilissime rugoso fere laevi; fronte subplana dense rugoso-punctata; prothorace semi-elliptico latitudine vix breviore, lateribus a basi ad mediam partem rectis parallelis, dein ad apicem fortiter rotundatis, angulis posticis subrotundatis, supra medio subgibbo, margine anteriori unise-

[9] Nach den mir vorliegenden 4 Frassfiguren.

[10] Departamental Notes on Insects that affect Forestry, E. P. Stebbing, Calcutta (1902), pl. XXIII.

riatim tuberculato, disco antice tuberculis transversis compressis valde infuscatis subconcentrice ordinatis, ad basim et latera subgranulate punctato, antice pilis, postice squamulis albidis adsperso; elytris subcylindricis, latitudine multo longioribus, striato-punctatis, punctis magnis, striis haud impressis, interstitiis planis, vix perspicue uniseriatim punctatis, punctis minimis, multo magis distantibus quam in striis, squamulis ac pilis albidis uniseriatim dispositis.

Long. 1.36 mm., lat. 0.53 mm.; prothoracis longitudo: 0.50 mm.; prothoracis latitudo: 0.53 mm.; elytrorum longitudo: 0.86 mm.; elytrorum latitudo: 0.53 mm.

MINDORO, Calapan, P. I. (*J. L. Webb* legit).

Type No. 1420 in der Entomologischen Sammlung des Bureau of Science, Manila, P. I.

1 Cotype in meiner Sammlung.

Lang gestreckt, fast cylinderförmig, blass gelb, Kopf und vorderer Teil des Prothorax rötlichgelb; Augen vorn ausgerandet; Scheitel äusserst fein gerunzelt, fast glatt; Stirn wenig gewölbt, fast flach, dicht und grob punktiert; Halsschild etwas kürzer als breit, die Seiten von der Basis bis über die Mitte hinaus gerade und parallel, hierauf bis zur Spitze stark gerundet, die Hinterecken nur wenig abgerundet, oben in der Mitte stark erhöht, am Vorderrande mit einer Reihe von Tuberkeln, vorn auf der Scheibe mit zahlreichen quergestellten schmalen Höckerchen, welche fast in concentrischen Kreisen angeordnet sind, nach der Basis hin und auf den Seiten körnig punktiert, vorne mit Haaren, nach hinten mit einzelnen blass-gelben Schuppen bedeckt. Die Flügeldecken fast cylinderförmig, viel länger als breit, in Reihen gross punktiert, die Zwischenräume flach und äusserst fein einreihig punktiert, die Punkte viel weiter auseinanderstehend als in den Punktstreifen, zwischen den Streifen abwechselnd Reihen von Schuppen und Haaren.

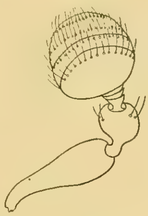

FIG. 3.—*Cryphalus squamulosus* Strohmeyer. Antenna. 12 × vergrössert.

Auffallend gross ist bei diesem *Cryphalus* das erste Glied der Fühlergeisel, (funiculus) (Fig. 3). Wegen der ausgerandeten Augen gehört der Käfer in die erste der von Eichhoff gebildeten *Cryphalus*-Gruppen.

## IPINÆ.

### COCCOTRYPES Eichhoff.

**Coccotrypes graniceps Eichhoff.**

*Coccotrypes graniceps* Eichhoff, Ratio, descriptio, emendatio Tomicinorum (1878), 314.

NEGROS, Maao, P. I. (1400, *Charles S. Banks*).

Futterpflanze: Cacao (*Theobroma cacao* Linn.)

Ein Exemplar in meiner Sammlung.

Eichhoff's Beschreibung passt sehr gut auf beide Exemplare nur fehlt den mir vorliegenden die kleine Stirnleiste. Dieses Merkmal ist aber bei vielen Borkenkäferarten sehr wenig constant, manchmal auch nur Geschlechtskennzeichen, jedenfalls genügt es nicht um diese Exemplare als eine andere Art anzusehen.

Bisher war dieser Käfer nur in Japan gefunden worden.

### OZOPEMON Hagedorn.[11]

**Ozopemon laevis** sp. nov.

Femina: oblonga, cylindrica, nitida, parce pilosa, flava, prothorace anteriore et capite flavo-ferruginea, elytris antice flavis, postice flavoferrugineis, irregulariter infuscatis; vertice tenuissime strigoso-punctato, linea mediana, valde infuscata; fronte antice leviter impressa, fortiter punctata, punctis magnis, linea mediana elevata, angusta non infuscata, prothorace fere globoso, latitudine vix breviore, lateribus leviter apice fortiter rotundato, angulis porticis rotundatis, dorso convexo subgibbo, anterius et in lateribus tuberculis vel rugis transversis infuscatis, subconcentrice ordinatis scabrato, postice in disco evidenter sat dense punctato; elytris cylindricis, prothorace vix latioribus et illo prope duplo longioribus, humeris rotundatis, lateribus longe ultra medium parallelis, dein fortiter conjunctim rotundatis, striato-punctatis, punctis sat magnis et confertis, striis antice haud postice obsolete impressis, interstitiis fere planis, laevibus, uniseriatim punctatis punctis minoribus quam in striis et magnis distantibus, apice retuso plano, interstitiis uniseriatim tuberculatis, tuberculis piliferis; abdomine subtus punctato et sparsim aequaliter pilosa.

Long. 4.1 mm., latitudo maxima 1.7 mm.; prothoracis longitudo 1.4 mm., latitudo 1.6 mm.; elytrorum longitudo 2.7 mm., latitudo 1.7 mm.

MINDORO, Calapan, P. I. (*J. L. Webb* legit).

Type ♀ No. 1421 in der Entomologischen Sammlung des Bureau of Science, Manila, P. I.

Paratype, ♀, in meiner Sammlung.

Weibchen. Länglich, cylindrisch, glänzend, dünn behaart, gelb, vorderer Teil des Halsschildes und Kopf rötlichgelb, Flügeldecken an der Basis gelb, nach hinten rötlichgelb mit unregelmässig verteilten dunkleren Trübungen, Scheitel sehr fein gestichelt punktiert, mit brauner Mittellinie; Stirn vorn leicht eingedrückt, stark punktiert, mit sehr schmaler etwas erhöhter Mittellinie; Halsschild fast kugelig, etwas breiter als lang, an den Seiten leicht, an der Spitze stark gerundet, nach vorn etwas verschmälert, Hinterecken stark gerundet, oben stark convex, vorn und auf den Seiten mit dunkleren quergestellten schmalen Körnchen, die fast in concentrischen Kreisen angeordnet sind, hinten auf der Scheibe deutlich und ziemlich dicht punktiert; Flügeldecken cylindrisch, wenig breiter

[11] *Deutsche Ent. Ztschr.* (1908), 382, und dieselbe *Ztschr.* (1910), 1, 2 und 3; Fig. 43a, 1. m.

als das Halsschild und fast doppelt so lang als dieses, Schultern gerundet, Seiten weit über die Mitte parallel, dann nach hinten stark gerundet, in Streifen punktiert, die Punkte ziemlich gross und dicht aneinandergereiht, die Streifen nur nach hinten leicht vertieft, die Zwischenräume fast eben und je mit einer Punktreihe versehen, die Punkte kleiner und weitläufiger als in den Streifen. Absturz abgeflacht, die Zwischenräume hier je mit einer haartragenden Körnchenreihe; Abdomen unterseits punktiert und dünn gleichmässig behaart.

FIG. 4.—*Ozopemon laevis* Strohmeyer. Antenna (scapus et funiculus).

Dieser Käfer gehört einer äusserst interessanten Gattung an, über deren Lebenweise noch gar nichts bekannt ist. Die Maxillarbewaffung (s. Abb.) welche aus breiten sichelförmigen Dornen besteht, deutet jedoch darauf hin, dass wir es mit einem Bastbewohner und keinem technisch schädlichen Holz-Insekte zu tun haben, trotzdem die äussere Form sehr an *Xyleborus*-Arten erinnert, zumal das Halsschild ziemlich deutlich gebuckelt ist.

FIG. 5.—*Ozopemon laevis* Strohmeyer. Mentum (palpi labiales et ligula).

**Ozopemon major** sp. nov.

Oblongus, cylindricus, nitidus, parce pilosus, nigropiceus, prothorace, capite, antennis pedibusque rufescentibus; fronte nitida, obsolete punctata, antice leviter impressa; prothorace latitudine vix breviore, lateribus, fere rectis, apice fortiter, rotundato, angulis posticis subrectis vix rotundatis, dorso convexo subgibbo, anterius et in lateribus tuberculis vel rugis transversis subconcentrice ordinatis scabrato, postice subtilissime parce punctato, nitido; elytris cylindricis, prothorace vix latrioribus et illo prope duplo longioribus, humeris rotundatis, lateribus fere usque ad apicem parallelis, dein fortiter conjunctim rotundatis, striato-punctatis, punctis parvis non confertis, striis haud impressis, interstitiis latis planis laevibus alternatim irregulariter uni- vel biseriatim parcius punctatis, punctis minoribus et multo magis quam in striis distantibus; declivitate postica subtruncatoretusa, convexiuscula, ambitu postice acutius marginato, interstitiis uniseriatim tuberculatis, tuberculis aureo setosis.

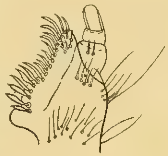

FIG. 6.—*Ozopemon laevis* Strohmeyer. Maxilla.

Longitudo 6.0 mm.; longitudo thoracis 2.1 mm.

LUZON, Bataan, Limay, P. I. (*R. J. Alvarez* legit).

Type No. 12007 in der Entomologischen Sammlung des Bureau of Science, Manila, P. I.

Paratype in meiner Sammlung.

Langgestreckt, cylinderförmig, glänzend, wenig behaart, dunkel pechfarben; Halsschild, Kopf, Antennen und Beine rötlich-braun. Stirn

glänzend undeutlich punktiert mit einem wenig vertieften Längseindrucke in der Mitte; Halsschild kaum kürzer als lang, Seiten fast gerade, vorn stark gerundet, Hinterecken fast rechtwinkelig, wenig abgerundet, oben stark convex, in der Mitte etwas gebukelt, auf der vorderen Hälfte und auf den Seiten quergerunzelt, die Erhöhungen beinahe in concentrischen Kreisen angeordnet, hinten glatt sehr sparsam und fein punktiert, glänzend; Flügeldecken cylinderförmig, kaum breiter als das Halsschild aber fast doppelt so lang, die Schultern gerundet, die Seiten weit über die Mitte parallel, alsdann gemeinsam gerundet, in Streifen punktiert, die Punkte klein und nicht sehr dicht gestellt die Streifen nicht vertieft, die Zwischenräume breit, eben, glatt, abwechselnd unregelmässig ein- und zweireihig punktiert mit äusserst feinen weit getrennt stehenden Punkten; Flügeldecken-Absturz ziemlich abschüssig, wenig gewölbt, nach hinten ziemlich scharf gerandet, die Zwischenräume hier mit je einer Reihe goldgelbe Haare tragenden Körnchen.

Diese *Ozopemon*-Art ist die grösste under allen bisher beschriebenen und ähnelt bei oberflächlicher Betrachtung in der Form sehr einem Bostrychiden aus der Gattung *Sinoxylon*.

Bisher sind nur die folgenden Arten dieser Gattung bekannt geworden:

1. *Ozopemon rugatus* Blandford (Sarawak, Borneo).
2. *Ozopemon sumatranus* Blandford (Sumatra, Mt. Singalang).
3. *Ozopemon gravidus* Blandford (Sarawak, Borneo).
4. *Ozopemon regius* Hagedorn (Sumatra).
5. *Ozopemon theklae* Hagedorn (Sumatra).
   var. *sirambeanus* Hagedorn (Si-Rambé, Sumatra).
   var. *singalangicus* Hagedorn (Mt. Singalang, Sumatra).
6. *Ozopemon obanus* Hagedorn (Mentawei Inseln).
7. *Ozopemon fuscicollis* Hagedorn (Java u. Sumatra).
8. *Ozopemon laevis* Strohmeyer (Mindoro, Philippines).
9. *Ozopemon major* Strohmeyer (Luzon, Philippines).

## III. SÆTIDENTATÆ.[12]

### XYLEBORINÆ.

#### XYLEBORUS Eichhoff.

**Xyleborus perforans** Wollaston.

*Tomicus perforans* Woll., Cat. Col. Mad. (1854), 96; Col. Hesperid. (1867), 113.

*Xyleborus kraatzii* Eichh., Berl. Ent. Ztschr. (1868), 152; Ratio Tomicinorum (1878), 374; Blandford, W. F. H., Report on the destruction of bear casks in India, London, 1893.

NEGROS, Maao, P. I. (416 *Charles S. Banks*).

Ein ♀ in meiner Sammlung.

Beide Exemplare gohören der kleinen Form des *X. perforans* an,

[12] Haged. *Ent. Blätter* (1909), 5, 163.

welche Eichhoff noch von der grösseren Form *affinis trennte.* Als Fundorte dieser Varietät waren bicher bekannt: Madeira, Indien, Ceylon, Andamanen, Tonkin, Siam, Malayische Region, Jamaika, Amazonas, Sechellen, Madagaskar, Ost-Africa und die Insel Principe. In meiner Sammlung befinden sich ausserdem Exemplare von den Cap Verde Inseln, Upolu (Samoa Ins.) sowie den Aroe- und Key-Inseln.

**Xyleborus perforans** var. **philippinensis** Eichh.

*Xyleborus kraatzii* var. *philippinensis* Eichhoff, Ratio Tomicinorum (1879), 343.

*Xyleborus perforans* var. *philippinensis* Eichhoff; Blandford, Report on the destruction of beer casks in India by the attacks of a boring beetle (*Xyleborus perforans* Woll.) London (1893), 12 u. 46 (Appendix).

Luzon, Laguna, Magdalena, P. I. (No. 410 *W. Schultze*) 1 ♀ in meiner Sammlung.

Futterpflanze: Cocosnuss (*Cocos nucifera* Linn.)

Diese Käfer unterscheiden sich von den typischen *X. perforans* Woll. (*X. kraatzii* Eichh.) durch ihre bedeutendere Grösse, dunklere, bräunliche, Färbung und die aufallend groben Punktstreifen auf den Flügeldecken. Auch sind die Streifen neben der Naht sehr deutlich vertieft. Ich halte es noch für sehr zweifelhaft ob dieser Käfer nur eine Varietät des *perforans* ist, die Entscheidung dieser Frage bei einem Vertreter dieser äusserst schwer zu bestimmenden *Xyleborus*-Gruppe muss verschoben werden bis mehr Material vorliegt.

Sobald mehr Exemplare dieser Art besonders auch Männchen, vorliegen, wird sich feststellen lassen, ob wir nur eine Varietät des *perforans* oder eine gute Art vor uns haben.

Subgenus **Eurydactylus** Hagedorn.

**Eurydactylus sexspinosus** Motschulsky.

*Eccoptopterus sexspinosus* Motsch., Bull. Moscou (1863), **36**, 515.

*Xyleborus abnormis* Eichhoff, Berl. Ent. Ztschr. (1868), 282.

*Xyleborus abnormis* Eichhoff, Ratio Tomicinorum (1879), 343.

*Platydactylus abnormis* Eichhoff, Notes Leyd. Mus. (1898), **8**, p. 25.

*Platydactylus sexspinosus Motsch.*, Blandford Indian Mus. Notes (1893), **3**, 65.

*Eurydactylus sexspinosus* Motsch., Hagedorn, Deutsche Ent. Ztschr. (1909), 733.

Negros, Mailum, P. I. (6498, *Charles S. Banks*).

Ein Exemplar in meiner Sammlung.

Als Fundorte waren bisher bekannt: Ceylon, Indien, Java, Sumatra, Philippinen (Luzon), für die Varietät *E. multispinosus* Hagedorn: Kamerun.[13] In meiner Sammlung habe ich ein Exemplar von *sexspinosus* aus Deutsch-Ost-Afrika; Hagedorn sah diesen Käfer auch in Zanzibar-Kopal. Als Nährpflanzen sind bis jetzt bekannt: Reis, Kakao und Kaffeebaum.

[13] *Deutsche Ent. Ztschr.* (1908), 377.

# PLATYPODIDÆ.

## CROSSOTARSUS Chapuis.

Gruppe: CROSSOTARSI GENUINI Chapuis.

**Crossotarsus comatus** Chapuis.

*Crossotarsus comatus* Chapuis, Monographie des Platypides (1865), 59, fig. 5.[14]

NEGROS, Maao, P. I. (417 *Charles S. Banks*).

Ein ♀ in meiner Sammlung.

Diese Art war bisher nur aus Celebes bekannt (*Chapuis*).

## PLATYPUS Herbst.

Gruppe: PLATYPI SULCATI Chapuis.

**Platypus jansoni** Chapuis.

*Platypus jansoni* Chapuis, Monographie des Platypides (1865), 244, fig. 146.

NEGROS, Maao, P. I. (413 *Charles S. Banks*).

Ein ♂ in meiner Sammlung.

Eichhoff kannte diese Art von Neu-Guinea, den Molukken und von Celebes.

Gruppe: PLATYPI CUPULATI Chapuis.

**Phatypus schultzei** sp. nov.

Mas: elongatus angustus, ferrugineo testaceus elytris apice infuscatis; vertice fortiter punctato punctis majoribus, linea mediana lævi infuscata; fronte rugose punctata, stria mediana parva impressa; prothorace nitido sparsim irregulariter punctato, linea mediana in postica parte, congeriebus punctorum duabus minimis ad latera lineae medianae; elytris evidenter striato-punctatis, stria suturali sulcata, interstitiis laevibus uniseriatim irregulariter punctatis punctis multo minoribus quam in striis, depressione postica circulari, inferne emarginata, emarginationis margine dente obtuso armato, angulo suturali obtuso.

Longitudo: 4.0 mm.

Fem: flavescens, fronte rugose punctata, linea mediana parva; prothorace sat dense punctulata, in postica parte congeriebus punctorum duabus magnis semi-ovalibus ad latera lineae medianae; elytris striato-punctatis, punctis parvis obsolete impressis, stria suturae proxima impressa, interstitiis sparsim uniseriatim punctulatis punctis minimis.

Longitudo: 4.4 mm.

NEGROS, Maao, P. I. (*Charles S. Banks* legit).

Typen 1 ♂ u. 1 ♀ No. 1594 in der Entomologischen Sammlung des Bureau of Science, Manila, P. I.

[14] Bekanntlich hat Chapuis die ♂ ♂ u. ♀ ♀ der Platypodiden durchgängig verwechselt; fig. 5 stellt deshalb nicht wie angegeben das ♀ sondern das ♂ dar.

Paratypen 1 ♂ u. 1 ♀ in meiner Sammlung.

Männchen. Langgestreckt, schmal, rötlichgelb, die Flügeldecken nach hinten dunkler; Scheitel stark und grob punktiert mit glatter dunkler Mittellinie; Stirn grob punktiert, mit kurzem strichförmigem Eindruck in der Mitte; Halsschild glänzend unregelmässig sparsam punktiert, hinten mit glatter Mittellinie, an den Seiten dieser Linie je ein kleiner aus wenigen (circa 8–10) deutlichen Punkten gebildeter Flecken; Flügeldecken mit deutlichen Punkstreifen, die beiden neben der Naht liegenden Streifen vertieft, die Zwischenräume glatt unregelmässig einreihig punktiert, die Punkte viel kleiner als diejenigen in den Streifen; der tiefe Eindruck am Flügeldecken-Absturz kreisförmig, innen ausgeschnitten und am Rande mit stumpfen Zahne jederseits versehen, Suturalecken der Flügeldecken stumpfwinkelig.

FIG. 7.—*Platypus schultzei* Strohmeyer. Depressio et marginatio postica. 15 × vergrössert.

Weibchen. Blass gelblich; die Stirn grob punktiert, die Mittellinie kurz; Halsschild ziemlich dicht fein punktiert, hinten neben der Mittellinie je ein grosser halbovaler Punktflecken, bestehend aus sehr zahlreichen äusserst kleinen Punkten; die Flügeldecken mit Punktstreifen, die Punkte kleiner als beim ♂ und wenig vertieft, die Suturalstreifen vertieft, die Zwischenräume sparsam einreihig fein punktiert.

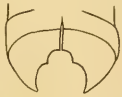

FIG. 8.—*Platypus lepidus* Chapuis. Depressio et marginatio postica. 15 × vergrössert.

Diese Art gehört in die Nähe von *Platypus lepidus* Chapuis und *Pl. caliculus* Chap.; unterscheidet sich jedoch von beiden Arten leicht durch die Form des Ausschnittes am Flügeldecken-Absturze (Fig. 7 u. 8).

In meiner Sammlung befinden sich genau gleiche Exemplare von der Insel Sumatra.

# ILLUSTRATIONEN.

TAFEL I.

Yakal-Rinde mit Frassfigur von *Sphærotrypes philippinensis* Strohmeyer.

TEXTFIGUREN.

FIG. 1 und 2. *Sphærotrypes philippinensis* Strohmeyer. Mentum, palpi labiales et maxillae. 80× vergrössert.

3. *Cryphalus squamulosus* Strohmeyer. Antenna. 125× vergrössert.

4–6. *Ozopemon laevis* Strohmeyer.

4. Antenna (scapus et funiculus).

5. Mentum (palpi labiales et ligula).

6. Maxilla.

7. *Platypus schultzei* Strohmeyer. Depressio et marginatio postica. 15× vergrössert.

8. *Platypus lepidus* Chapuis. Depressio et marginatio postica. 15× vergrössert.

TAFEL I.

THE PHILIPPINE JOURNAL OF SCIENCE,
D. General Biology, Ethnology and Anthropology.
Vol. VI, No. 1, February, 1911.

# NOTES ON THE DIGESTIVE SYSTEM OF HYDROCORAX.

By HOLTON C. CURL.
(*Surgeon, United States Navy.*)

Because of their peculiar appearance and strange habits, the hornbills have always been of popular and scientific interest, and a very large number of articles have been written about them.

Their method of nesting, mode of flight, and gross anatomy have been abundantly described, while some fairly good accounts of their habits have been given.[1]

In order to try to learn something regarding the periodical casting-off of the lining of the stomach, as described first by Bartlett,[2] I have recently made a series of histological sections of the various parts of the gastro-intestinal tract of *Hydrocorax hydrocorax* (Linnæus), and find facts of sufficient interest to record.

The best results are obtained by taking small portions of tissue from a recently collected bird and placing them in a 10 per cent aquous formalin solution for eighteen hours; from this, the tissue is transferred to 70 per cent alcohol, where it is kept until ready to use.

Within a few days one may embed the tissues in parafine, cut moderately thin sections, and stain by the Van Gieson or by the hæmatoxylin and eosin method. The Van Gieson stain has the very desirable quality of giving a perfect differentiation. Muscle stains yellow, connective tissue stains red, and colloid tissue stains orange.

By this stain, the muscular coat can readily be separated from the mucous and serous coats, while by its nuclear staining the cells are well-defined and add to the clearness of the picture.

Before giving a description of the sections, I wish to call attention to several statements, found in standard books, regarding hornbills and which I do not find to correspond with my examinations and observations of *Hydrocorax hydrocorax*. For example, Newton[3] says that the "horn-

[1] Newton, Dictionary of Birds, London (1893), 432–437.
[2] *Proc. Zool. Soc. London* (1869), 142–146.
[3] *Loc. cit.*

bill, at least in captivity, never has any fat about him." The species mentioned is often found to be extremely fat and it takes a long time to remove the thick layer from the skin, while the abdomen contains fat in quantities. In other specimens collected under similar conditions, very little fat is present. Again, the statement that the large hornbills make so much noise when flying that they "can be heard a mile," does not apply to the bird mentioned.

The most important thing which my findings tend to show to be in error, is regarding the muscular layers of the intestine. Authorities make the general statement that the circular layer of the intestine is found *external* to the *longitudinal* layer, as in the œsophagus. This is true in some birds, but in many it is by no means so. In *Hydrocorax*, in *Ætheopsar*, in *Anas*, and in *Bubulcus*, the Van Gieson stain shows clearly that the intestine has an *outer longitudinal* layer of muscle in contact with the peritoneum; next, internal to this, a *circular layer* and still more internally, a thinner longitudinal layer, with some oblique fibers and intimately blended with the submucosa. This last layer of muscle corresponds very closely to the muscularis mucosæ in mammals and is sometimes so developed as to become a fairly thick longitudinal layer. These layers are shown very clearly in the photomicrograph of the intestine of *Hydrocorax hydrocorax*. Anyone familiar with histological technique can verify the above in the genera mentioned, and I dare say in many others by using a two-thirds inch objective for routine and one-sixth inch for occasional differentiating.

In the following descriptions of the parts of the alimentary tract, the measurements given are from alcoholic specimens, previously run through the 10 per cent formalin and are slightly less than those from fresh material. The œsophagus, proventriculus, stomach, and intestine are described and photomicrographs given to show the histology.

The œsophagus is 200 millimeters in length and will admit the thumb when fully dilated; at the lower end it becomes funnel-shaped and increases in size as it reaches the proventriculus. The mucous membrane is thrown into longitudinal corrugations which run unbroken for almost the entire length; these corrugations project further into the lumen in front than behind throughout the upper three-fourths; in the lower fourth, they are of about equal size on all sides. Dilatation of the œsophagus does not obliterate them and the best-developed ones measure 2 millimeters in height.

A cross section shows microscopically that there is an external, circular, muscular layer; next, an internal, longitudinal layer intimately connected with the mucosa, in fact projecting inward into the bases of the rugæ.

The mucous membrane being thrown into longitudinal corrugations, a cross section gives a circle of inward projections with connective tissue frame work, the usual blood vessels, and covered with epithelium. A layer of globular cells lies beneath the epithelium and each opens by a

short duct on the free surface of the membrane. The deeper cells of the epithelium show round nuclei; these become flatter toward the free inner surface, and at the surface they are almost as flat as those seen in the skin. Apparently only simple mucus for lubrication is secreted by the lining of the œsophagus. The photomicrograph shows the structures quite well.

The proventriculus is 30 millimeters in length and the wall is 8 millimeters thick in the thickest part, just above the sphincter muscle which lies between it and the stomach. The inner surface is thickly set with the mouths of glands and when examined in a recently collected bird, is covered with a thick coat of sticky, mucoid material. On section, an outer fibrous coat is seen; next a strong, circular, muscular layer; then a longitudinal, muscular layer on which rests a layer of glands beneath the mucosa. The glands of this layer are large, each is inclosed in a connective tissue capsule and, somewhat like a salivary gland, presents a radiating, tubular structure with a central space in which there are very few cells and which is filled with mucoid material. Each gland (or at least those of the inner layers), opens on the free surface of the mucous membrane by a wide mouth, which passes through the mucosa proper. They resemble "Brunner's" glands in that they lie *below* the muscularis mucosæ. Internal to this glandular layer is the mucosa proper, of ordinary type, with villi projecting from the surface and with a network of muscle fibers, forming a *true, reticulate muscularis mucosæ.*

It is evident that the glandular layer of the proventriculus is a highly specialized structure, undoubtedly supplying the essential digestive fluid for this part of the tract. This is the more certain when we remember that the tough, deciduous membrane of the stomach, about to be described, would effectively prevent any digestive fluid which might be secreted by the glands of the stomach from coming in contact with the food.

The stomach of this large hornbill when empty, is oval with flattened sides and varies in thickness from 2 millimeters on the membranous sides, to 11 millimeters where the muscle is thickest. The muscle fibers cross in a radiating manner from one tendinous disk to the similar disk on the other side, and are reinforced by numerous other fibers arising from the membranous, internal muscle-sheath. There is the usual modification of fibers at the cardiac and pyloric openings and at the cardiac opening a round, cord-like, circular muscle, 5 millimeters in diameter, acts as a strong sphincter between the proventriculus and stomach. At the pyloric opening the sphincter is less well-marked.

The entire lining of the stomach is corrugated and presents a brownish, irregular surface. On section this is seen to be due to the deciduous membrane which, depending on its stage of development, is more or less loosely attached to the stomach proper. The cardiac and pyloric openings are but 15 millimeters apart. As the entire organ when empty

is 50 millimeters in diameter, and when filled with food twice as large, it can readily be seen that when the lining membrane is cast off entire, it forms a sac with the two openings close together at the top.

A B

FIG. 1.—Stomach of *Hydrocorax hydrocorax* showing: A, deciduous membrane almost ready to be cast off (note its separation); B, stomach before the preparatory separation has taken place.

In a stomach where the sac-like lining is about to be cast off, it separates from the entire surface of the stomach before its upper, neck-like portion separates finally around the pyloric opening, at which point it thins down rapidly and disappears just above the sphincter muscle. On the other hand, in a specimen where the lining membrane is in an earlier stage of formation (i. e., soon after the last one has been cast off), no macroscopical separation can be demonstrated, although microscopically the line of future separation is well seen.

On section the stomach is found to have an external serous coat, a thick muscular coat, and a mucous lining. There is nothing peculiar about the serous and muscular layers. The mucous membrane shows closely studded, long, finger-like villi which have tubular glands at their bases and are covered by a single layer of cells with large nuclei.

When the deciduous membrane is just beginning to form, the spaces between the villi are filled with colloid-appearing material which stains a bright orange-yellow by the Van Gieson method. A little later this layer becomes thicker and lies as a continuous coat over the entire inside of the stomach. Before it is ready to be thrown off, it becomes in fact, thicker than the mucosa itself. The deciduous membrane is of homogeneous structure, is quite tough, and on its mucous-membrane side is an accurate cast of the rugæ of the stomach. It seems certain that this layer, which is so peculiarly cast off, is formed by secretion from the glands of the stomach and after reaching its full thickness, separates spontaneously, leaving the glands to begin at once the formation of a new sac.

The intestine is from 920 to 950 millimeters in length and, having no cæcum, is not clearly divisible into large and small portions except possibly by its structure when examined from within. The mucous

membrane of the upper three-fourths has a velvet-like feel and shows long villi lying close together. At a point about 250 millimeters from the rectum and about where one would expect to find the cæca, if such did exist, there is a short section of the gut which is dilated, has thin walls, and an entirely different type of villi. This section is about 70 millimeters in length, and below it one again finds villi of the same type as occur in the upper intestine.

The intestine differs from the œsophagus in the position of the muscular layers. A section shows externally the serous coat, made up of connective tissue; next to this a well-developed longitudinal muscular coat; next, internal to this, the circular muscular layer. The muscularis mucosæ lies internal to this circular layer and then comes the mucosa with its epithelial lining. This is shown perfectly in the cross-section of the gut where the outer longitudinal fibers are seen cut across and the circular fibers are seen in their circular plane. Simple alveolar glands lie at the base of the villi.

After this brief description of the digestive tract, the following points appear worth considering: I have collected three large hornbills at practically the same time, months after the breeding season was over, and found the deciduous membrane in three different stages of development; one was separated entirely from the stomach except for a narrow zone around the cardiac opening, one was just beginning to form, and the third was in an intermediate stage. At other seasons the same has been found and in some, the sac, ready to be cast off, was packed full of indigestible parts of the fruit on which the birds were feeding. It seems reasonable to suppose that, at least when the breeding season is past, the food, mixed with, and acted upon by, the secretion of the proventricular glands, passes into the deciduous sac lining the stomach; here muscular action completes the mixing, triturates the food, and prepares the digestible parts to pass over into the duodenum. The refuse is then periodically ejected in the membranous sac. Whether this routine is changed at the breeding season, I can not say.

Another point of interest is the abrupt change in the character of the mucous membrane in the short section of the gut at about the point one would expect to find cæca; this, together with the dilitation and thinning of the intestinal wall at this point may suggest the explanation of the absence of cæca in certain species where the diet is similar to that of others in which these organs are present. Is it not possible that the mucous membrane of the gut itself takes on, in these specialized areas, the functions performed by the cæca in other birds? In *Bubulcus* for example, where the bud-like, single cæcum is very short, the mucous membrane of the adjacent gut contains numerous masses of lymphoid tissue, from 90 to 250 millimeters in diameter, not found in other parts

of the intestine, but found in the cæcal bud itself. As we know, in many animals where there is no appendix, the head of the cæcum contains a great increase of lymphoid tissue.

Numerous interesting superstitions and beliefs concerning the *calao,* or great Philippine hornbill, are found among the natives and are worth collecting, while a systematic and accurate study of the bird's habits would well repay the observer.

# ILLUSTRATIONS.

PLATE I.

FIG. 1. Cross section of œsophagus of *Hydrocorax hydrocorax.*

2. Longitudinal section of proventriculus of *Hydrocorax hydrocorax:* A, Mucous membrane; B, muscularis mucosae; C, specialized glands; D, muscular coats.

PLATE II.

FIG. 3. Section of stomach of *Hydrocorax hydrocorax:* A, Deciduous membrane; B, mucosa; C, muscular coats; D, peritoneum.

4. Cross section of intestine of *Hydrocorax hydrocorax:* A, Peritoneum; B, *longitudinal* layer of muscle; C. *circular* layer of muscle; D, muscularis mucosæ beneath the mucosa.

TEXT FIGURE.

FIG. 1. Stomach of *Hydrocorax hydrocorax* showing: A, deciduous membrane almost ready to be cast off (note its separation); B, stomach before the preparatory separation has taken place.

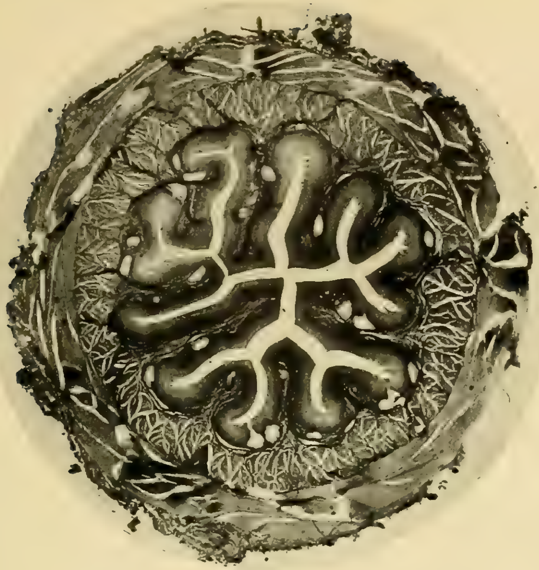

FIG. 1.


FIG. 2.

PLATE I.

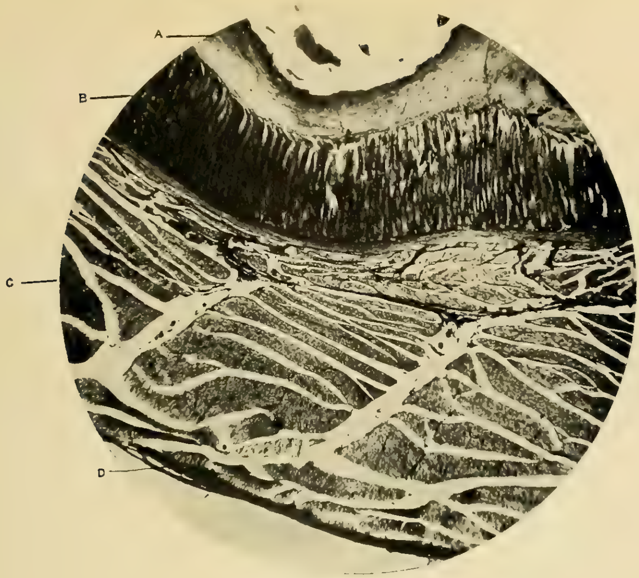


FIG. 3.


FIG. 4.

PLATE II.

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# NOTES ON A COLLECTION OF BIRDS FROM NORTHERN NEGROS.

By Richard C. McGregor.

*(From the Ornithological Section, Biological Laboratory, Bureau of Science, Manila, P. I.)*

The earliest paper on the birds of Negros that I have seen is one by Walden and Layard [1] on a collection made in the southern part of the island by Mr. L. C. Layard. Of the seventeen species there recorded three are described as new. In 1875 Walden published his monograph, "A List of the Birds Known to Inhabit the Philippine Archipelago,"[2] including therein some species obtained in Negros by the German collector Meyer, and giving the total number of species known from the island as thirty-eight. Two years later, Mr. A. H. Everett began his explorations in the Philippine Islands which resulted in the discovery of the many new species of Philippine birds described and figured by Tweeddale in the Proceedings of the Zoölogical Society of London, 1877–1879. Everett [3] collected at Valencia and Dumaguete in the southern part of the island and secured specimens of fifty-six species; twenty-four of these had not previously been recorded from Negros and six of them had not been known from the Philippines. *Dasycrotapha speciosa,* the most remarkable of the three new species discovered by Everett, was described and figured in a separate paper.[4]

In 1874 Steere began his work in the Philippine Islands, visiting Negros during the next year, where he obtained specimens of thirty-eight species of birds, among them being the following new species which were described by Sharpe.[5]

*Oriolus steeri, Dicæum hæmatostictum, Æthopyga magnifica, Anthreptes chlorigaster,* and *Phapitreron nigrorum.*

As a result of the collections made by the Steere Expedition,[6] eighty-one species were recorded from Negros. Two species, *Cryptolopha*

[1] *Ibis* (1872), 93–107, pls. 4–6.

[2] *Trans. Zool. Soc. London* (1875), 9, 125–252, 23–34.

[3] *Proc. Zool. Soc. London* (1878), 280–288.

[4] *Proc. Zool. Soc. London* (1878), 114, pl. 9.

[5] *Nature* (1876), 14, 297, 298; *Trans. Linn. Soc. London,* 2d. ser. Zool. (1877), 307–355, pls. 46–54.

[6] A list of the birds and mammals collected by the Steere Expedition to the Philippines, Ann Arbor, 1890.

*nigrorum* and *Abrornis olivacea,* collected by the Steere Expedition were described and figured by Moseley.[7]

Bourns and Worcester[8] added twenty-four species to the Negros list and described the following as new: *Phapitreron maculipectus, Batrachostomus menagei, Ceyx nigrirostris, Oriolus nigrostriatus* (= *steeri*), *Æthopyga bonita, Hyloterpe winchelli,* and *Rhinomyias albigularis.*

Grant's[9] report on Whitehead's collection includes notes on eighty-six species, three being described as new: *Turdus nigrorum, Brachypteryx brunneiceps,* and *Cittocincla nigrorum.*

In 1894 Clarke began a series of papers based upon birds collected in Negros by W. A. Keay.[10] In these papers eighty-six species are recorded and one new species, *Phlogœnas keayi,* is described and figured.

In February and March, 1909, Mr. Andres Celestino made collections in the vicinity of Cadiz, northern Negros, and the species obtained by him are listed in the present paper. The following species are believed to be here recorded from this island for the first time: *Astur trivirgatus, Tachornis pallidior, Cyanomyias cœlestis,* and *Æthopyga bonita.*

## LIST OF SPECIES.

### TRERONIDÆ.

**Osmotreron axillaris** (Bonaparte).

One female.

**Phapitreron maculipectus** Bourns and Worcester.

The collection contains nine specimens of this rare dove. The collector gives the length as 280 to 292 millimeters; eyes brown; bill black; feet red; nails brown.

*Measurements of Phapitreron maculipectus.*

| Sex. | Wing. | Tail. | Culmen from base. | Tarsus. |
|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* |
| Male | 145 | 118 | 24 | 21 |
| Do | 143 | 120 | 23 | 20 |
| Do | 145 | 118 | 24.5 | 20 |
| Do | 141 | 114 | 27 | 18 |
| Do | 147 | 120 | 24 | 19 |
| Female | 149 | 119 | 23 | 19 |
| Do | 140 | 112 | 23 | 18 |
| Do | 145 | 118 | 22 | 18 |
| Do.[a] | 137 | 102 | 22 | 19 |

[a] This specimen is in poor plumage.

[7] *Ibis* (1891), 46, 47, pl. 2.

[8] *Minnesota Acad. Nat. Sci. Occ. Papers* (1894), 1, 1–64.

[9] *Ibis* (1896), 325–565.

[10] *Ibis* (1894), 532–535; Second Contribution, *Ibid.* (1895), 473–479; Part III, *Ibid.* (1898), 119–124; Part IV, *Ibid.* (1900), 351–361, pl. 8.

**Phapitreron nigrorum** Sharpe.

Three males and one female.

**Leucotreron occipitalis** (Bonaparte).

Two males in fine, adult plumage. This yellow-breasted fruit pigeon was taken in Negros by Whitehead also.

**Muscadivores chalybura** (Bonaparte).

One specimen.

**Zonophaps poliocephala** (Hartlaub).

One pair in fine adult plumage.

### COLUMBIDÆ.

**Columba griseogularis** (Walden and Layard).

Two females. Some individuals of this species from Batan, Batanes, have the bills considerably longer than the Negros examples, but the difference is not constant.

### ARDEIDÆ.

**Bubulcus coromandus** (Boddaert).

One female in winter plumage.

### FALCONIDÆ.

**Astur trivirgatus** (Temminck).

One specimen, an immature male. This species has not, so far, been recorded from Negros.

**Spilornis panayensis** Steere.

One adult male in good plumage.

### PSITTACIDÆ.

**Prioniturus discurus** (Vieillot).

A pair, taken February 24, and a female, taken March 10, are in fine plumage.

**Tanygnathus lucionensis** (Linnæus).

Two adult males; in one specimen the blue of the crown and nape is unusually dark.

**Loriculus regulus** Souancé.

One male and three females of the central island colasisi were collected; the male is in immature plumage.

### ALCEDINIDÆ.

**Ceyx bournsi** Steere.

The only specimen, a female, of Bourns's kingfisher in this collection has a considerable quantity of black mixed with the deep blue of the upper surface.

**Halcyon moseleyi** (Steere).

One female specimen of this very rare kingfisher was collected on February 19. Wing, 108 millimiters; tail, 86; culmen from base, 46; tarsus, 15. Length, taken by the collector, 265 millimeters.

### BUCEROTIDÆ.

**Penelopides panini** (Boddaert).

One pair of the Panay tarictic.

**Craniorrhinus waldeni** Sharpe.

Three males and two females of Walden's hornbill, all in good plumage.

### HEMIPROCNIIDÆ.

**Hemiprocne major** (Hartert).

One male specimen; wing, 141 millimeters.

### MICROPODIDÆ.

**Tachornis pallidior** McGregor.

One specimen, without sex mark, was collected on March 10. This is the first record of the species.

### CUCULIDÆ.

**Surniculus velutinus** Sharpe.

In an adult female from Cadiz most of the rectrices are conspicuously bordered with white and several of the longer upper tail-coverts are faintly tipped with the same color. This species was taken in Negros by Whitehead also.

**Hierococcyx sparverioides** (Vigors).

Two males in adult plumage.

**Cacomantis merulinus** (Scopoli).

One male specimen.

### CAPITONIDÆ.

**Xantholæma roseum** (Dumont).

Two specimens, male and female.

### PICIDÆ.

**Yungipicus maculatus** (Scopoli).

Four males and one female were taken in February.

**Chrysocolaptes xanthocephalus** Walden and Layard.

One male and one female in good plumage.

**Thriponax hargitti** Sharpe.

*Thriponax hargitti* Clarke, Ibis (1895), 475–477; McGregor, Man. Phil. Bds. (1909), 1, 409.

This collection contains three males and four females of Hargitt's black woodpecker; all of them are in good plumage and well prepared.

In five specimens there is a wide, buffy white band across the rump, in one male the white band in narrow, and in one female most of the back and uropygium are bare. The lower mandible in all these Negros specimens is whitish. The Masbate and Negros birds appear to be of the same species and they must be called *T. hargitti* unless Steere's *T. philippinensis* can be shown to be distinct from the *Thriponax* of Palawan.

### PITTIDÆ.

**Pitta erythrogastra** Temminck.

One female.

### HIRUNDINIDÆ.

**Hirundo rustica** Linnæus.

One female swallow, taken March 17, differs from the other specimens from Negros in having the pectoral band continuous across the fore breast and in having the white of the under surface distinctly washed with pale ochreous-pink.

**Hirundo gutturalis** Scopoli.

One female and two male swallows, March 17, are of the eastern species.

### MUSCICAPIDÆ.

**Cyanomyias cœlestis** (Tweeddale).

The celestial-blue flycatcher is represented in the present collection by an adult female. There appears to be no previous record of this species for Negros.

**Rhipidura albiventris** (Sharpe).

Three specimens of the white-bellied fantail.

**Xeocephus rufus** (Gray).

Two males and one female.

**Cryptolopha olivacea** (Moseley).

Two specimens of the olivaceous flycatcher warbler.

### CAMPOPHAGIDÆ.

**Artamides panayensis** Steere.

Two males and one female.

**Edolisoma panayense** Steere.

This very distinct and handsome cuckoo shrike is represented in the present collection by eight males and six females.

### PYCNONOTIDÆ.

**Iole guimarasensis** Steere.

Two males and one female.

## TIMELIIDÆ.

**Dasycrotapha speciosa** Tweeddale.

The type of this curious species was collected by A. H. Everett at Valencia in southern Negros and was described and figured by Tweeddale in the Proceedings of the Zoölogical Society of London for 1878. Other specimens were secured in Negros by the Steere Expedition and by the Menage Expedition. The collection now under consideration contains a series of seven males and one female. The sexes appear to be similar in color. The structure of the feathers is very similar to that found in the various species of *Mixornis* and *Macronous,* but the feathers of the lower back are not noticeably lengthened, while the orange-colored feathers above and behind the eyes are stiff and harsh. The length of specimens in the flesh, as given by the collector, is from 145 to 150 millimeters.

Measurements of four males and one female are given herewith.

*Measurements of Dasycrotapha speciosa.*

| Sex. | Wing. | Tail. | Culmen from base. | Bill from nostril. | Tarsus. |
|---|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* | *mm.* |
| Male | 67 | 56 | 16 | 10.5 | 18.5 |
| Do | 70 | 58.5 | 17 | 11 | 19 |
| Do | 68 | 56 | 17 | 11 | 18 |
| Do | 68 | 59 | 16 | 11 | 17 |
| Female | 65 | 53 | 15 | 10 | 18 |

## TURDIDÆ.

**Kittacincla superciliaris** Bourns and Worcester.
*Cittocincla nigrorum* Grant, Ibis (1896), 547.

Upon comparison of an adult male shama from Negros with adult males from Ticao and Masbate, the characters given for *Cittocincla nigrorum* do not appear to be valid. In the first place the superciliary stripe in all three species is practically of the same width. In *K. luzoniensis* alone the stripes are connected across the forehead. This species is also distinguished by the rusty brown rump, large white spots on rectrices, and other characters. In *K. superciliaris* the spots on the rectrices are much reduced or may be altogether obliterated. The length of tarsus in the original description of *K. superciliaris* is clearly a mistake.

A specimen from Cadiz, Negros, marked female, differs from the male as follows: The superciliary stripes are continued forward above the lores to the base of bill; the upper parts are less glossy; the chin and throat are white and there is a narrow band of black across the chest.

*Measurements of Kittacincla.*

| Species. | Sex. | Wing. | Tail. | Culmen from base. | Tarsus. |
|---|---|---|---|---|---|
| | | *mm.* | *mm.* | *mm.* | *mm.* |
| *K. luzoniensis* | Male | 82 | 82 | 18 | 26 |
| *K. superciliaris* | do | 80 | 73 | 19 | 26 |
| Do | do | 83 | 74 | 19.5 | 27 |
| Do | do | 79 | 66 | 18 | 25 |
| *K. nigrorun* | do | 78 | 71 | 17 | 27 |
| Do | Female | 74 | 67 | 17.5 | 26.5 |

**Pratincola caprata** (Linnæus).

One male and one female.

## SYLVIIDÆ.

**Megalurus tweeddalei** McGregor.

One specimen.

## LANIIDÆ.

**Hyloterpe winchelli** Bourns and Worcester.

Three males and two females.

## PARIDÆ.

**Pardaliparus elegans** (Lesson).

One male, March 19, and one female, January 29, from Cadiz, do not differ from specimens taken in Bataan Province, Luzon.

## SITTIDÆ.

**Callisitta œnochlamys** (Sharpe).

One male and two females.

## CERTHIIDÆ.

**Rhabdornis mystacalis** (Temminck).

A male, the only specimen of *Rhabdornis* in the present collection, differs from specimens taken in Luzon in having the bill conspicuously longer, the feet larger, and the color of the back and rump darker. If additional specimens from Negros show that these characters are constant, the species may be known as *Rhabdornis longirostris.*

## ZOSTEROPIDÆ.

**Zosterops nigrorum** Tweeddale.

Two specimens; one of these is slightly albinistic, having five rectrices white, washed with pale yellowish green.

I have long suspected that a series of birds of this genus, collected by me on the little island of Cresta de Gallo, represented a distinct species. With topotypes of *Zosterops nigrorum* at hand I still hesitate to separate the Cresta de Gallo individuals as a species, although in the latter the wing, tail, and bill average longer and the color of the upper parts is more uniform and more yellowish.

*Measurements of Zosterops nigrorum.*

| Locality. | Wing. | Tail. | Culmen from base. | Tarsus. |
|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* |
| Negros | 54 | 42 | 12.5 | 15 |
| Do | 55 | 38 | 12 | 16 |
| Masbate | 52 | 36.5 | 13 | 15.5 |
| Ticao | 56 | 38 | 13 | 16 |
| Cresta de Gallo | 58 | 44 | 14 | 17 |
| Do | 58 | 44 | 14 | 18 |
| Do | 57.5 | 43 | 13.5 | 17 |
| Do | 56.5 | 43 | 14.5 | 16 |

## DICÆIDÆ.

**Dicæum hæmatostictum** Sharpe.

Three males and two females.

**Dicæum dorsale** Sharpe.

Four males and one female in fresh plumage.

## NECTARINIIDÆ.

**Æthopyga magnifica** Sharpe.

One adult male; the types of this species were collected in Negros.

**Æthopyga bonita** Bourns and Worcester.

Two full-plumaged males from Negros differ in no way from a male from Ticao and a male from Cebu. This appears to be the first record of the Visayan sunbird from the Island of Negros.

**Cinnyris guimarasensis** Steere.

One male and two females of this species were taken in March.

## MOTACILIIDÆ.

**Anthus rufulus** (Vieillot).

One specimen, January 29.

## PLOCEIDÆ.

**Munia jagori** Martens.

Two specimens.

**Uroloncha everetti** (Tweeddale).

One specimen, February 4.

## ORIOLIDÆ

**Oriolus steeri** Sharpe.

Thirteen males and six females.

## DICRURIDÆ.

**Dicrurus mirabilis** Walden and Layard.

Two males.

THE PHILIPPINE JOURNAL OF SCIENCE,
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Vol. VI, No. 1, February, 1911.

# ON A QUINARY NOTATION AMONG THE ILONGOTS OF NORTHERN LUZON.

By OTTO SCHEERER.

Within the area of Austronesian languages there are represented, in a pure or in a modified form, all those systems of numeration which are designated as quinary, decimal, or vigesimal notations, according as they are based upon the counting of the digits of only one hand, of both hands, or of both hands and feet.

From the Philippines in particular none but decimal systems have hitherto been recorded, not excepting such tribes as the Negritos, Tagbanwas and similar people of low culture.[1]

In view of this general use of decimal series of numerals in the Philippines it will be of interest here to make known a case of quinary notation in northern Luzon as found by me some time ago in an old Egongot (i. e., Ilongot) catechism dating from 1792, and declared by its authors, three Spanish missionaries, to be a revision of a still older text.[2]

As is to be supposed, the catechism does not give the Egongot numerals by way of demonstration. They occur in the text mostly in the form of ordinals in such places as "The ten commandments," "The articles of faith," and the like. Collecting these ordinals I obtain the following list:

| | | | |
|---|---|---|---|
| *Ta onbucoug* | the first | *Ta catambiang no siyet* | the sixth |
| *Ta cadua* | the second | *Ta catambiang no dua* | the seventh |
| *Ta catgo* | the third | *Ta catambiang notgo* | the eighth |
| *Ta caapat* | the fourth | *Ta catambiang no apat* | the ninth |
| *Ta catambiang* | the fifth | *Ta catampopoo* | the tenth |

[1] For a full treatise on the numerals of these systems see the praiseworthy paper of Professor Frank R. Blake in *Journ. Am. Or. Soc.* (1907), 28: Contributions to Comparative Philippine Grammar, Part II.

[2] "Catecismo de doctrina cristiana en Egongot, escrito por el M. R. P. Fray Francisco de la Zarza, O. S. F. Dado á luz por Fernando Blumentritt, . . . y aumentado por el mismo editor con equivalencias del texto egongot ó ilongote en castellano, tagalog y moro de Maguindanao." (Vienna, 1893). As will be shown, the form "Egongot" for "Ilongot" represents an idiomatic pronunciation of this word among at least that section of the Ilongots whose dialect is used in this catechism. For this reason it is employed by me in this paper as a term distinctive for that dialect.

*Ta,* appearing before each of these numerals, is an Egongot demonstrative particle acting as article.

*Onbucoug* is the equivalent, not of "one," but of "first." The word occurs, in this or related forms, in several other passages. There is evidently a typographical confusion between "*u*" and "*n*." Compare—

*Na mucong toi Dios Ama, ta Dios Anac, at ta Spiritu Santo?*
Is first (superior) the God Father to God Son and to Ghost Holy?

*Auan-a namucoug, auan-a naonod de, ten sisiet ta enca Dios de.*
There is not being first, there is not following behind among them, for only one the Godship their.[3]

*Ca* in *cadua, catgo,* etc., is a prefix making ordinals from cardinals, not only in Egongot but in several other dialects of Luzon.

Eliminating these three factors from the above list, and observing the composition of the numerals from "six" to "ten," we have all the necessary material for establishing the following list of Egongot cardinals:

| English. | Egongot. | Pangasinan. | English. | Egongot. | Pangasinan. |
|---|---|---|---|---|---|
| one | *siyet* (*siet*) | *isa* | six | *tambiang no siyet* | *anem* |
| two | *dua* | *dua* | seven | *tambiang no dua* | *pito* |
| three | *tego* | *talo* | eight | *tambiang notgo* | *ualo* |
| four | *apat* | *apat* | nine | *tambiang no apat* | *siam* |
| five | *tambiang* | *lima* | ten | *tampo* (*tampoo*) | *sampolo* (*samplo*) |

The cardinals *tego, tambiang,* and *tampo* (*tampoo*) occur as such repeatedly in the text; *siet* was quoted above in its restrictive form *sisiet.* For comparison with a series of typical Philippine numerals the corresponding Pangasinan cardinals have been added.

"One" is expressed in Egongot by a word, *siet* or *siyet,* which, compared with Pangasinan as well as with any other Philippine dialect, shows hardly any affinity, at least not *prima facie.*

From "two" to "four" Egongot uses numerals which, though varying in form, are the common property of all these dialects. The characteristic variation in the case of the numeral "three" in Egongot is the change from general Philippine *l* or *d* to *g*. The same change, typical for Egongot, is seen in such other words as *gema,* "hand" (Tagalog *lima*), *gake,* "male" (Tag. *lalaki*), *uge,* "again," "anew" (Tag. *ulî*), etc. It is this sound-change which accounts also for the form "Egongot" instead of "Ilongot," the change from *i* to *e* being the ordinary fluctuation of these vowels.

"Five" is expressed, not by *lima,* in which all Philippine dialects agree, and which, as we have just seen, would be here *gema,* but by the idiomatic term *tambiang,* formed of a prefix *tam* (cf. *tampo*) before a stem, *biang.*

[3] *Op. cit.*, p. 19.

From "six" to "nine" the Egongot numerals are clearly seen to express "five and one," "five and two," "five and three," and "five and four," which shows that, once "five" is reached by counting the fingers of one hand, the count is begun anew. That the particle *no* is the equivalent of "and," is proved by a phrase of the text: *dit bucolot no nauguin bininiaguen,* "the pagans and bad Christians." [4]

The numeral for "ten" is *tampo,* evidently with long *o* (compare the variant *tampoo*). It consists of the prefix *tang,* which also appears in *tambiang,* changed to *tam-* by the influence of the labial that follows, and stem *po* or *poo,* which is the common Philippine *polo* or *pulo* with elision of *l.*

For the two numerals "one" and "five," in Egongot we find no immediate correspondent among the forms of the equivalent numerals in the generality of the other dialects. But apart from these two words we have as characteristic of this series of Egongot numerals that it is based on a clearly quinary plan, and that the words used are for the greater part the common property of a family of languages which, as far as it is represented in the Philippines, uses none but decimal systems. Similar cases of quinary series we find in Formosa.[5]

It remains to be pointed out that, although the Egongot plan is quinary, as far as I have been able to illustrate it above, it is only imperfectly so. If it were purely quinary the numeral for "ten," instead of being expressed by a distinct word, would be given by such a term as "five-five" or "two-fives." Again, beyond "ten," the advance would be by fives, not by tens. But this is a question not to be decided from the text before me, which lacks examples of higher numerals. I may, however, add that there exists a variant of the Egongot speech here illustrated, the speakers of which use a purely decimal series from "one" to "ten," and it may be believed that this will ultimately supersede the quinary series. For the present it must suffice that evidence has been given here of the existence in the Philippines of a representative of the quinary notation which is generally assumed to be a more primitive form of counting than the decimal system.

[4] *Op. cit.*, p. 27.

[5] *Cf.* the numerals given under 'Pep. Paz.' and 'Shek. T.' in Table I of The Batan Dialect as a Member of the Philippine Group of Languages. *Division of Ethnology Publications*, Manila (1908), 5, pt. I.

# REVIEW.

**The Provinces of China, Together with a History of the First Year of H. I. M. Hsuan Tung, and an Account of the Government of China.** Reprinted from "The National Review" (China) as "The National Review Annual," 1910. Pp. 188. Cloth. Shanghai: "The National Review" Office, 1910.

Those among the millions of otherwise well-informed dwellers in Europe and America who plead guilty to the charge of ignorance of matters Chinese, brought against them by Colonel Bruce in his preface to this work, would indeed seem to have reason to be grateful to the publishers for their effort to dispel a part, at least, of that ignorance by offering here a fairly concise survey of the essentials and potentials of each of the provinces of China.

After an introductory chapter on the extension, the population and the political division of the country in general accompanied by a table showing the present condition of Chinese railway enterprise as distributed among the different competing foreign countries, the work dedicates a chapter to each of the eighteen provinces and four dependencies (Tibet, Sinkiang, Mongolia, Manchuria), discussing them fairly uniformly along the following general lines: position, area, density of population, topography, climate, natural resources, communications, cities and chief towns, and illustrating the text by sketch-maps of each province. The concluding chapters, "The first year of Hsuan Tung" and "the Government of China," give a cursory review of the main political events during the year 1910, respectively of the different departments and boards entrusted with the administration of national affairs. Three different indexes facilitate a rapid reference to particular points (places, productions, etc.) on which information is sought.

The work is in the main a compilation of data collected from the best available sources; i. e., partly from official publications, such as the Customs Reports, and partly from works like those of Richthofen, Little, Hosie, and others. It should prove useful to those who look upon China as a field for the extension of their commercial or industrial activity. In any case, the reader, before opening the book, will do well to make up his mind as to whether the interest he takes in matters Chinese is proof against every once in a while there being flung into his face, between the pages he is expected to read, a flaring advertisement of cement, cooking ranges, pianos, or other foreign commodity.

Otto Scheerer.

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# JOURNAL OF SCIENCE

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VOL. VI APRIL, 1911 No. 2

# LES FORAMINIFÈRES DANS LE TERTIAIRE DES PHILIPPINES.

Par le Professeur HENRI DOUVILLÉ.

(*École Nationale Supérieure des Mines, Paris.*)

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24. L. tournoueri var. borneënsis)

DESCRIPTION DES ESPÈCES:

L. insulæ-natalis
L. richthofeni
L. formosa
**L. inermis** sp. nov.
**L. smithi** sp. nov.
L. verbeeki
L. inflata
L. cf. marginata
Miogypsina irregularis
Amphistegina niasi
A. cf. mamillata

III. RÉSUMÉ ET CONCLUSIONS.

## AVANT-PROPOS.

Les explorations géologiques des Philippines et en particulier les récents travaux de M. Warren D. Smith publiés dans "The Philippine Journal of Science" ont montré que le Tertiaire de cet archipel était constitué: 1° à la base par un système inférieur avec couches de Charbon exploitées, qui a été attribué à l'Eocène, et 2° par un système supérieur miocène caractérisé par des calcaires à Orbitoïdes.

L'étude des Foraminifères qui m'ont été communiqués par le géologue précité, permet de préciser cette classification: on peut en effet subdiviser le système supérieur et distinguer 3 séries de couches.

I. Le système inférieur lignitifère caractérisé par l'association des *Nummulites* et des *Lépidocyclines.*

II. Le système moyen caractérisé par l'abondance des grandes *Lépidocyclines,* et la présence des *Alvéolines.*

III. Le système supérieur où abondent les petites *Lépidocyclines* et les *Miogypsina.*

Cette succession est la même que celle que l'on observe dans toute l'Indonésie et en particulier à Bornéo,[1] où ces trois divisions correspondent aux couches que j'ai distinguées par les lettres D,—E, F, G,—H. Elles peuvent être facilement parallélisées avec les couches de l'Aquitaine.

I. Le système inférieur D, partout caractérisé par l'association des Nummulites et des Lépidocyclines, représente le STAMPIEN ou Oligocène supérieur.[2]

II. Le système moyen E, F, G représente alors les couches de Peyrère et de St-Géours, c'est-à-dire l'AQUITANIEN.

III. Le système supérieur H se rattache complètement par sa faune aux couches de St-Etienne d'Orthe et surtout à celles de St-Paul près Dax (Abesse, Mandillot), gisement type du BURDIGALIEN.

Je vais passer en revue les différentes formes que j'ai pu examiner et je reviendrai en terminant sur les caractères comparatifs de ces faunes avec celles des autres parties de l'Indonésie, et celles de l'Europe.

## DESCRIPTION DES ESPÈCES.

### 1° FORAMINIFÈRES IMPERFORÉS.

#### ALVEOLINELLA. Pl. A, fig. 1.

Ce genre est représenté par une série de moules médiocrement conservés dans une roche très tendre, jaunâtre, recueillie à Sibud Gulch, Old Alpaco Mines, Cebú, et portant le numéro 273. Cette roche est qualifiée de marne, mais c'est plutôt un grès tendre avec ciment calcaire peu abondant.

[1] Douvillé, H. Les Foraminifères dans le Tertiaire de Bornéo. *Bull. Soc. géol. France,* (1905), VI, 5, 435.

[2] Conformément aux travaux les plus récents, la limite entre l'Oligocène et le Miocène, ou entre l'Eogène et le Néogène est placée entre le Stampien et l'Aquitanien proprement dit.

Elle renferme un grand nombre d'empreintes de Foraminifères parmi lesquelles quelques unes sont fusiformes allongées, ayant environ 5 millimètres de longueur sur 1 millimètre de diamètre. Elles se rapportent incontestablement à des Alvéolinidés. Sur quelques échantillons il m'a semblé distinguer sur l'empreinte de la cloison terminale plusieurs rangées d'ouvertures. Ces fossiles appartiendraient donc au groupe de l'*Alv. quoyi,* pour lequel j'ai proposé le genre *Alveolinella.* A ce sujet je ne puis mieux faire que de citer l'observation très intéressante faite par M. Verbeek:[3] après avoir décrit plusieurs *Alveolina* des couches à Nummulites présentant tous *une seule rangée* d'ouvertures, il dit quelques mots de formes rares trouvées dans l'étage inférieur du terrain miocène, et il constate qu'elles présentent 3 et même 4 rangées d'ouvertures les unes au dessus des autres, "circonstance qui jusqu'à présent n'a jamais été observée, dit-il, chez des Alvéolines fossiles, mais seulement chez les espèces vivantes (*Alv. Quoyi*). Par là, les Alvéolines miocènes se distinguent nettement des espèces éocènes et oligocènes." Ces *Alveolinella* de Java sont indiquées comme associées à de nombreuses *Orbitolites* dans un calcaire grisâtre d'âge miocène ancien un peu au dessus des grès quartzeux éocènes. Elles sont un peu plus petites que l'espèce de Cebú, leur longueur maximum étant de 3.5 millimètres sur une épaisseur de 0.75 millimètre, mais il ne faut pas oublier qu'elles ont été seulement observées en coupe sur des plaques minces.

*Gisement.*—Dans les Philippines cette forme est accompagnée par des Orbitolites, des Operculines et des Polystomelles; les couches qui renferment cette faune sont riches en Mollusques, parmi lesquels on signale *Dolium costatum.* Martin[4] a eu l'occasion d'étudier un échantillon d'une marne terreuse tendre provenant de la mine même d'Alpaco et riche en coquilles de Lamellibranches et de Gastropodes. C'est vraisemblablement la même couche, la différence de couleur provenant de la différence de gisement, les roches jaunes en affleurements devenant habituellement bleues en profondeur; il signale dans cet échantillon un fragment de grande Lépidocycline, et en outre *Vicarya callosa.* De ces rapprochements il semble qu'on peut conclure que ces couches sont à la base du système moyen et représentent l'Aquitanien inférieur, comme à Bornéo et vraisemblablement aussi à Java.

**Orbitolites martini?** Verbeek. Pl. A, fig. 2.

La même roche jaunâtre de Old Alpaco Mine, renferme d'assez nombreux moules d'une Orbitolite mince ayant de 5 à 6 millimètres de diamètre. Sur les empreintes on distingue un grand nombre d'anneaux concentriques étroits ayant au pourtour environ 0.05 millimètre de largeur, constitués par des moules de logettes ayant à peu près la même distance d'axe en axe. C'est exactement la disposition figurée par M.

[3] Verbeek et Fennema, Description géologique de Java et Madoura (1896), 1141.
[4] *Centralbl. f. Mineral., Geol. u. Paläon.* (1901), 326.

Verbeek (Pl. IX, fig. 135). Malheureusement la disposition des loges en coupe verticale reste bien obscure: la figure 134 de cet auteur indique pour la forme type 2 rangées d'ouvertures, ce qui placerait cette forme dans les *Sorites;* mais c'est seulement un dessin et d'après le texte les coupes ne donnent pas de caractères précis. Dans les spécimens des Philippines l'impression du pourtour de la coquille semble indiquer des ouvertures en rangées plus nombreuses, tandis que les moules de logettes conservées sur les bases correspondraient peut-être à une couche superficielle rappelant celle des *Marginopora.*

Les deux formes sont donc incomplètement connues, et leur rapprochement n'est que probable.

*Gisement.*—Dans les Philippines cette forme accompagne les *Alveolinella,* dans des couches qui sont indiquées comme inférieures au Calcaire à *Orbitoïdes;* Aquitanien inferieur.

### 2° FORAMINIFÈRES PERFORÉS.

#### OPERCULINA.

Les couches du Miocène des Philippines renferment de nombreuses Operculines qui paraissent se rapporter à 2 types un peu différents.

**Operculina costata** d'Orb. Pl. A, fig. 3.

> *Operculina costata* d'Orbigny, Prodrome, étage 26, Falunien B, (1852), n° 2881, 155.

C'est une forme très voisine de l'*Op. complanata* et qui s'en distingue par ce que la surface est ornée de côtes correspondant aux cloisons.

J'en rapproche une forme abondante dans des calcaires tendres jaunâtres de Minanga river (Cebú, n° 277) où elle est associée à de nombreux *Cyclocypeus communis;* elle atteint 7 à 8 millimètres dans son plus grand diamètre et se rattache nettement au groupe de l'*Op. complanata* par sa taille, la largeur du dernier tour et ses cloisons fortement et regulièrement arquées. Certains échantillons sont presque aussi lisses qu'*Op. complanata,* mais le plus grand nombre est fortement costulé et les costules se décomposent en granulations plus ou moins nombreuses; elles sont toujours plus accentuées dans le jeune.

*Gisement.*—D'après l'abondance du *Cycl. communis* dans ces couches, je les considère comme un peu plus récentes que les calcaires à grandes Lépidocyclines et représentant l'Aquitanien supérieur.

**Operculina costata, var. tuberculata.** Pl. A, fig. 4.

Je distingue sous ce nom des individus plus petits que les précédents, atteignant seulement 4 à 4.5 millimètres; ils sont plus renflés, de section lenticulaire et présentent de forts tubercules sur les côtes. Ils paraissent difficiles à distinguer des jeunes de l'espèce précédente; peut-être en représentent-ils seulement la forme A. Ils se distinguent de l'*Op. gaimardi* d'Orbigny, des mers actuelles par leur taille plus grande et leur forme plus renflée.

Ils se recontrent presque à tous les niveaux, mais ils sont surtout abondants dans les grès tendres de Old Alpaco Mine, où ils se présentent à l'état de moule (éch. nº 273).

**HETEROSTEGINA.** Pl. A, fig. 5.

Les *Heterostegina* de grande taille ne sont ordinairement pas rares dans les couches à Orbitoïdes.

J'en ai observé un bel échantillon de 5 millimètres de diamètre fixé sur une *Lepidocyclina insulæ-natalis* du Barrio de Mesaba.

**Cycloclypeus communis** Martin. Pl. A, fig. 6.

*Cycloclypeus communis* K. Martin, Untersuchungen über die Organisation von Cycloclypeus und Orbitoïdes. Niederland. Arch. f. Zoöl. (1880), 5, Pls. 13 et 14.

Carpenter a montré dès 1856 (*Phil. Trans. Roy. Soc. London* (1856), **146,** 547) la constitution de ce genre curieux. C'est en réalité une *Heterostegina* dont le développement est devenu annulaire (cyclostègue) et qui épaissit son test comme *Orbitoïdes,* mais sans former de logettes latérales; il existe donc comme dans ce dernier genre une couche équatoriale de logettes, mais elles sont rectangulaires comme dans *Heterostegina.* Les couches latérales sont compactes et plus épaisses au centre, ce qui donne aux échantillons une forme lenticulaire ordinairement très aplatie.

L'ornementation dans *Cycl. communis* est formée par une série de granules disposés suivant les anneaux d'accroissement, et correspondant à des piliers analogues à ceux des *Orbitoïdes.*

Cette espèce est très abondante dans les couches supérieures de l'île de Batan (éch. nº 8) où elle accompagne les *Myogipsina* et dans les calcaires tendres jaunâtres du Barrio de Mesaba (Cebú, nº 273), où elle est associée à *Operculina costata.* J'ai déjà montré précédemment que le premier niveau appartenait au Burdigalien, tandis que le second paraît devoir se placer au sommet de l'Aquitanien. Cette espèce dans les Philippines se montrerait ainsi à la base de H et dans G, à peu près au même niveau qu'à Bornéo; il est même possible que les calcaires tendres jaunâtres du Barrio de Mesaba représentent exactement les couches à silex du groupe F de Bornéo.[5]

**ROTALIA.**

J'ai pu extraire de la roche tendre de Old Alpaco Mines (éch. nº 273) de petits échantillons qui ressemblent beaucoup à *Rotalia schröteriana* Parker et Jones, avec ses lignes d'enfoncements le long des cloisons, mais qui en diffèrent par une forme moins dissymétrique. Il semble que Carpenter a eu sous les yeux une forme bien voisine quand il dit:[6] "dans une remarquable variété des îles Fidji la spire est plus symétrique . . . . . . de sorte que la coquille a presque la même forme que *Polys-*

[5] *Bull. Soc. géol.* France (1905), IV. 5, 445. [6] Introduction, 213.

*tomella craticulata;* elle se rapproche du reste beaucoup de ce type par la disposition du dépôt exogène et par la manière dont les passages interseptaux s'ouvrent extérieurement le long du bord des cloisons." A la page suivante il revient sur ces analogies avec *Polystomella,* qui montrent que ces deux types sont extrêmement voisins l'un de l'autre. Il est curieux de retrouver aux Philippines ces deux formes associées dans le même gisement.

### POLYSTOMELLA.

Forme voisine de *P. craticulata,* mais à callosité ombilicale un peu moins large et moins développée; on sait que ce genre est abondant à partir du Tertiaire moyen. Cette forme est associée à la précédente dans le grès tendre de la vieille mine d'Alpaco (éch. n° 273).

Une forme très voisine est indiquée par des sections dans les calcaires oligocènes à petites Nummulites de Caracaran de l'île de Batan (éch. n° 2). Une coupe axiale passant par le centre montre que c'est bien un *Polystomella* et non un *Rotalia.* Ce type aurait donc apparu dès la fin de l'Oligocène.

**Nummulites subniasi** sp. nov.

*Nummulina variolaria* Brady, On Some Fossil Foraminifera from the West Coast District of Sumatra. *Geol. Mag.* (1875), II, 2, 552.

Les calcaires subordonnés aux couches de charbon de l'île de Batan renferment de nombreuses petites Nummulites qu'il ne semble pas possible de distinguer de celles que M. Verbeek a recueillies autrefois dans l'île de Nias et qui ont été décrites et figurées par Brady sous le nom de *N. variolaria;* cet auteur donne comme dimension maxmium 2 millimètres et ses figures indiquent bien des individus mégasphériques. Les échantillons des Philippines sont légèrement plus grands, 2.7 millimètres, et sont également mégasphériques comme l'indique la coupe ci-jointe.

La forme de la spire, la direction et la courbure des cloisons concordent parfaitement.

En 1896, M. Verbeek a repris l'étude de cette espèce et a figuré à nouveau sous le nom de *Nummulites niasi* II, une forme un peu plus grande, ayant un diamètre de 4 millimètres mais certainement microsphérique comme le montre le diamètre de la loge initiale pour lequel M. Verbeek donne la dimension de 0.02 millimètre. Comme le *Nummulites niasi* I Verbeek est incontestablement une Amphistégine, on pourra réserver à la *N. niasi* II microsphérique le nom spécifique de *niasi* Verbeek, et donner à notre forme mégasphérique le nom de *subniasi.*

FIG. 1.—*Nummulites subniasi* sp. nov. de la formation charbonneuse de l'île de Batan, gr. 10 fois.

### LEPIDOCYCLINA.

Dans un mémoire précédent et à l'exemple de MM. Verbeek et Fennema, j'ai divisé ce genre en deux sections, pour lesquelles j'ai proposé les noms suivants:

1° Les *Eulepidina* généralement de grande taille, caractérisées par leurs loges équatoriales en spatule ou en hexagone subrégulier et par leur nucleus du type embrassant.

2° Les *Nephrolepidina,* presque toujours petites, à loges équatoriales ogivales, en losange ou en hexagone allongé et à nucleus du type réniforme.

Je vais examiner séparément chacun de ces groupes.

#### 1° Section des **Eulepidina.**

Dans les Philippines ces grandes formes paraissent cantonnées dans les Calcaires à Orbitoïdes inférieurs et dans les marnes subordonnées; le Tertiaire de cet archipel présente de telles analogies avec celui des Archipels voisins, qu'il n'est pas possible de séparer l'étude de leurs fossiles. Je passerai donc tout d'abord rapidement en revue les espèces qui ont été proposées dans cette région. Elles sont malheureusement le plus souvent très incomplètement définies et il ne sera pas toujours possible de les caractériser d'une manière certaine.

L'étude approfondie que j'ai pu faire des différentes espèces de *Lepidocyclina* m'a montré que les caractères les plus précis sont fournis par la disposition des piliers et des logettes latérales; ces caractères ne sont que très rarement indiqués, les espèces étant principalement établies sur de simples sections.

FIG. 2.—*Lepidocyclina sumatrensis,* gr. 6 fois, d'après la figure originale de Brady.

C'est Brady qui en 1875 [7] a décrit et figuré les premières espèces d'après des échantillons recueillis par M. Verbeek et envoyés par ce géologue à Rupert Jones; ils provenaient en particulier de l'île de Nias. La plupart des formes ont été attribuées à tort à des espèces déja connues, *Nummulina variolaria, N. ramondi, Orbitoïdes papyracea, O. dispansa;* une seule espèce nouvelle est proposée:

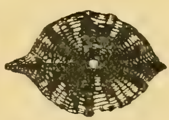

FIG. 2bis.—Section d'un échantillon de l'île de Nias, gr. 10 fois.

(1) *Orbitoïdes sumatrensis,* très bien figurée (loc. cit. Pl. XIV, fig. 3, ab.); c'est une forme globuleuse, presque sphérique, ayant environ 3 millimètres de diamètre, sur une épaisseur de 2.5 environ. Elle présente à l'équateur une mince collerette très étroite, dont le contour présente

[7] *Geol. Mag.* (1875), 2, 532. On Some Fossils Foraminifera from the West Coast District of Sumatra.

des parties saillantes dessinant une sorte d'étoile; la première loge paraît très petite.

Elle a été recueillie dans l'île de Nias. M. le Dr Verbeek a bien voulu me communiquer plusieurs échantillons provenant de la localité type. J'ai pu m'assurer ainsi qu'elle appartenait à la section des *Nephrolepidina.* Elle diffère très notablement des formes de l'Aquitaine qui en ont été rapprochées.

Quelques années après, en 1880, le professeur K. Martin [8] a fait connaître de nouvelles espèces qu'il range avec raison dans les *Lepidocyclina.*

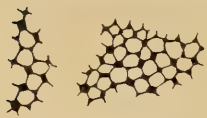

FIG. 3.—*Lepidocyclina carteri* Martin, disposition des piliers près de la surface, gr. 20 fois.

(2) *Orbitoïdes carteri* (loc. cit., p. 11, Pl. XIV, fig. 2, 2a, 2b, 2c) ; elle est lenticulaire et légèrement renflée au centre, elle atteint un diamètre de 26 millimètres avec une épaisseur maximum de 2 millimètres. La surface ne montre d'après l'auteur aucune ornementation; toutefois la fig. 2a montre des piliers inégaux, pentagonaux, quadrangulaires, ou triangulaires dont l'épaisseur est indiquée comme étant de 0.05 à 0.12 millimètre. Sur une des préparations qui m'a été communiquée par le professeur R. Martin, on distingue des piliers peu développés se présentant comme des épaississements des points de rencontre des cloisons, peu nombreux et irrégulièrement distribués; ils sont triangulaires, quadrangulaires et très exceptionnellement pentagonaux. Mais la préparation est très voisine de la couche équatoriale et il est possible que les piliers se développent davantage dans les couches plus extérieures et dans la partie centrale qui est un peu renflée; et en effect, les coupes axiales montrent de gros piliers qui sont probablement des pustules et qui atteignent la dimension indiquée de 12 millimètres. Les logettes latérales ont de 0.08 à 0.11 millimètre de diamètre et leurs parois 0.03 à 0.035 d'épaisseur. Elles forment des couches très nombreuses, 30 environ au centre. La figure 26 montre les perforations du toit de certaines logettes sous la forme de fins canaux parallèles.

La gangue est un tuf grossier renfermant des fragments de roche éruptive et de nombreux *Cycloclypeus communis.*

La localité originaire est au Nord de Sindangabaran? (Java). D'après la forme des logettes équatoriales cette espèce appartient bien certainement à la section des Eulepidina.

(3) *Orbitoïdes gigantea* (loc. cit., p. 20, Pl. XIV, fig. 3, 3a, 3b, 3c, 3d) diffère de la précédente par sa taille plus grande, presque double, 50 millimètres; la forme générale est la même. Une section tangentielle

[8] Untersuchungen über die Organisation von Cycloclypeus und Orbitoïdes. *Niederl. Arch. f. Zoöl.* (1880), 5.

communiquée par le professeur K. Martin, montre une série de piliers assez gros atteignant 0.15 millimètre et entourés de 6 à 7 logettes; ils constituent donc de véritables pustules, assez souvent séparées par deux ranqées de logettes; celles-ci sont de forme assez irrégulière et leur plus grande dimension varie de 0.1 à 0.2 millimètre.

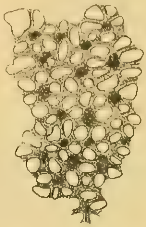

Fig. 4.—*Lepidocyclina gigantea* Martin, disposition des piliers près de la surface, gr. 20 fois.

D'après l'auteur cette espèce se distingue aussi de la précédente par ses logettes latérales plus hautes et formant des couches moins nombreuses.

L'espèce est fondée sur un seul échantillon incomplet provenant de Tjidamar (Java).

(4) *Orbitoïdes radiata* (loc. cit., p. 22, Pl. XIV, fig. 4) présente sur sa surface un bouton central d'où partent 9 rayons saillants qui n'atteignent pas le bord. Elle provient de la même localité que l'*O. carteri.* L'auteur l'a d'abord rangée dans les *Actinocyclina,* mais il a reconnu plus tard [9] que c'était une véritable *Lepidocyclina.*

Le même auteur avait décrit [10] en 1891 une cinquième espèce:

(5) *Lepidocyclina multipartita,* petite forme de 6 à 7 millimètres de diamètre, très renflée au milieu et présentant quelques grosses pustules; la couche équatoriale se renfle beaucoup à la périphérie et elle se subdivise alors dans la hauteur d'une manière irrégulière. Elle appartient vraisemblablement à la section des *Nephrolepidina.* Elle provient des couches à *Cycl. annulatus.*

En 1896, MM. Verbeek et Fennema [11] publiaient leur grand ouvrage sur l'île de Java et donnaient d'excellentes figures d'un grand nombre de Foraminifères, *Alveolina, Nummulites, Operculina, Orbitoïdes,* etc. Ils indiquent pour la première fois que les Orbitoïdes à loges équatoriales rectangulaires (distinguées en 1868 par Gumbel sous les noms de *Discocyclina, Rhipidocyclina, Aktinocyclina,* et *Asterocyclina,* réunies plus tard en 1891 par Munier-Chalmas sous celui d'*Orthophragmina*), se recontrent exclusivement dans le tertiaire ancien avec les *Nummulites,* tandis que les *Lepidocyclina* caractérisent le Miocène.

Ces auteurs distinguent dans ce dernier genre 6 espèces réparties en 3 couples, mais sans leur donner de noms: le premier avec des logettes équatoriales en losange appartient à la section des *Nephrolepidina;* il comprend les formes microsphériques I A (*a, d, h, l*) et mégasphériques I B (*g, k*). Les deux autres ont des logettes équatoriales en spatule et font partie de la section pour laquelle j'ai proposé le nom de *Eulepidina;*

[9] In Schlumberger, 1900.

[10] *Samml. Geol. Mus. Leiden* (1881), Neue Folge, 1, Heft I, 7, Pl. 1. fig. 7–10.

[11] Description géologique de Java et Madura.

elles sont petites, 5 à 6 millimètres, II C (*f*) et II D (*e*), ou grandes, atteignant jusqu'à 70 millimètres, III E (*b, m, n*) et III F (*c, ć, p*). Ils considèrent les *O. carteri* et *O. gigantea* comme se rapportant probablement à l'espèce III E, et ils ajoutent que "certaines espèces se recontrant dans 2 ou même 3 étages, il ne semble pas qu'elles puissent convenir pour établir des subdivisions dans les couches néogènes."

En 1899, Newton et Holland,[12] reprennent l'étude des principales formes décrites par Brady: c'est ainsi qu'ils donnent le nom de (6) *Lepidocyclina verbeeki* a l'*Orb. papyracea* de Brady à laquelle ils réunissent les formes *g* et *k* de Verbeek et Fennema. Or, ces différentes formes sont mégasphériques et l'*O. papyracea,* de même que la forme *k,* proviennent de Padang; le nom de *Lep. verbeeki* doit donc strictement être réservé pour les formes mégasphériques de Padang. J'en ai sous les yeux un grand nombre d'échantillons communiqués par M. Verbeek et provenant de la localité type; ils ont de 5 à 7 millimètres de diamètre; ils sont amincis sur les bords et assez fortement renflés au centre; quand la surface est bien conservée elle est lisse mais on y distingue néanmoins une vingtaine de petites pustules subégales ayant de 0.15 à 0.2 millimètre; cette disposition est assez bien indiquée sur une coupe tangentielle figurée par Newton et Holland (loc. cit., Pl. IX, fig. 10) dans laquelle cependant les pustules sont plus petites et paraissent indiquer un individu jeune.

Vers 1900, Rupert Jones et Chapman ont décrit et figuré[13] un grand nombre d'Orbitoïdes provenant de l'île Christmas; malheureusement les échantillons n'ont pas été isolés et les espèces ne sont établies que sur des sections effectuées dans la roche qui les contient et, par suite, d'une orientation incertaine: aussi la plupart d'entre elles doivent être considérées comme insuffisamment définies.

Ainsi (7) *L. meodispansa,* rapprochée de la forme *d* de Verbeek et Fennema est une *Nephrolepidina* de 5 millimètres de diamètre qui ressemble beaucoup à *Lep. verbeeki*; cependant les pustules paraissent plus grosses et moins nombreuses. Le caractère distinctif, indiqué par les auteurs et fondé sur le renflement plus brusque de la partie centrale, n'est guère applicable. En outre, il ne semble pas d'après les sections figurées que l'espèce soit microsphérique comme *d* de Verbeek et Fennema.

(8) *L. insulæ-natalis* est exceptionellement susceptible d'une définition plus précise. Sa grande taille, 12.5 à 19 millimètres, la range

[12] On some tertiary Foraminifera from Borneo and their comparison with similar forms from Sumatra. *Ann. & Mag. Nat. Hist.* (1901), VII, 7, 215.

[13] On the Foraminifera of the Orbitoidal limestones and reef rocks of Christmas island. Ce mémoire fait partie d'une monographie de ces îles; le tirage à part ne porte ni titre général, ni date, ni indication d'éditeur. On sait que l'île Christmas est située à environ 3 degrés 1/2 de latitude au Sud de la pointe occidentale de Java.

dans les *Eulepidina;* la figure type (loc. cit., Pl. XX, fig. 5) est une section oblique et ne passant pas par le centre, comme le montre l'inégalité des deux moitiés. Il en résulte que la moitié la plus grande représente une coupe en partie perpendiculaire au rayon, c'est à dire tangentielle. Elle montre bien la disposition des piliers, qui, comme l'indique expressément l'auteur, "entourent les logettes polygonales." Cette disposition est bien indiquée sur la figure ci-jointe qui représente un grossissement de la figure type; elle est tout à fait caractéristique du groupe du *Lepidocyclina dilatata.*

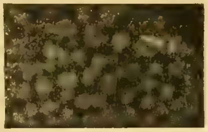

Fig. 5.—Reproduction grossies 5 fois de la partie centrale de la figure type de MM. Rupert Jones et Chapman, le grossissement de cette dernière figure n'est pas indiqué.

C'est donc à tort que Schlumberger a attribué à cette espèce un échantillon de Java dont la surface présente de nombreuses pustules *entourées par* les logettes. Cette disposition est inverse de la précédente et il faudra conserver pour l'espèce de ce dernier auteur le nom qu'il avait tout d'abord choisi *L. ngembaki.*

(9) *L. ephippioïdes* est rapproché à la fois de l'espèce précédente qui est un *Eulepidina* et de *L. verbeeki* qui est un *Nephrolepidina;* c'est dire combien elle est vaguement définie. L'épaisseur des cloisons pourrait faire penser à une forme du groupe de *L. formosa* Schlumb.

(10) *L. murrayana* à 4 rayons n'est probablement pas une forme étoilée comme l'ont pensé les auteurs, mais simplement une forme en selle; les caractères donnés sont dès lors tout à fait insuffisants.

(11) *L. andrewsiana;* le seul caractère indiqué est le fort renflement central avec large collerette, il est également insuffisant.

En 1900, Schlumberger [14] décrit deux nouvelles espèces de Lépidocyclines:

(12) *L. ngembaki,* qu'il attribue à tort à *L. insulæ-natalis* J. et Ch. comme je viens de le montrer. Dans cette dernière espèce les piliers restent polygonaux, se rejoignent en grossissant et entourent les logettes, tandis que dans la nouvelle espèce les piliers restent isolés et se transforment en pustules entourées chacune par une rosette de logettes. Cette disposition est très nettement indiquée par l'auteur (loc. cit., Pl. VI, fig. 4) sur une coupe tangentielle grossie 20 fois. Il faut donc reprendre le nom que l'auteur avait adopté tout d'abord, avant d'avoir reçu le mémoire de Rup. Jones et Chapman (loc. cit., p. 130).

Les piliers sont très petits et ne dépassent pas 0.1 millimètre, tandis que les logettes qui les séparent ont au centre seulement 0.06 de largeur.

L'échantillon type avait été recueilli à Ngembak (Java) par M. Verbeek.

[14] Notice sur deux espèces de Lépidocyclines des Indes néerlandaises. *Samm. d. geol. r. Museums in Leiden* (1900) I, 6, fasc. 3, 128.

(13) *L. martini* (loc. cit., p. 131, Pl. VI, fig. 5 et 8) est une forme étoilée de Batoe Koetjing (résidence de Madoera) qui a été rencontrée dans les Calcaires à *Cycloclypeus*.

Le même auteur publiait un peu plus tard [15] en 1902 une troisième espèce de Lépidocycline: (14) *L. formosa* qui mérite de nous arrêter un instant. Elle n'est connue que par des coupes; or l'une d'elles (loc. cit., Pl. VII, fig. 2) montre une partie centrale quadrangulaire prolongée aux 4 sommets par des branches étroites. L'auteur a pensé qu'il s'agissait d'une forme rayonnée: en réalité c'est simplement une forme discoïde recourbée en selle: on sait que dans ce cas la couche équatoriale se rapproche d'un hyperboloïde dont les sections dans le voisinage du plan tangent au centre sont constituées par deux hyperboles; de là les 4 branches de la figure précitée.

Au centre cette coupe montre un nucleus du type embrassant. Grâce à l'obligeance de M. le Professeur Haug j'ai pu retrouver dans la collection Schlumberger, conservée à la Sorbonne, une moitié de l'échantillon dont il vient d'être question; une préparation tangentielle a montré la disposition des logettes latérales séparées par des cloisons épaisses et paraissant dépourvues de piliers. Sur un autre échantillon de la même provenance, les logettes atteignent 0.2 millimètre de diamètre et les cloisons qui les séparent ont en moyenne 0.1 millimètre d'épaisseur.

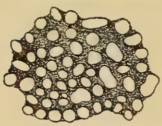

FIG. 6.—*Lepidocyclina formosa*, disposition des logettes sur une section de l'échantillon type de l'espèce, gr. 20 fois.

L'échantillon lui-même présente une partie centrale globuleuse atteignant 6 millimètre de diamètre avec une épaisseur de 4.2 millimètres (et non de 2 millimètres comme l'auteur l'indique par erreur); tout autour s'étend une collerette mince de 6 millimètres environ de largeur et de moins de 1 millimètre d'épaisseur.

Cette espèce provient de Teweh (Bornéo).

Newton et Holland avaient déjà publié en 1900 [16] quelques notes sur des Foraminifères de Formose; ils reviennent sur le même sujet en 1902 [17] et signalent dans ces calcaires une série de petites Lépidocyclines *L. sumatrensis*, *L. verbeeki* et une espèce nouvelle (15) *L. angularis* présentant un renflement central orné de grosses pustules et légèrement déprimé au centre, ce que indique l'existence d'une couronne de pustules plus développées que les pustules du centre; c'est une disposition qui rappelle celle de certaines *L. morgani*. Le diamètre est de 3 millimètres

[15] Sur un Lepidocyclina nouveau de Bornéo. *Ibid.* (1902), **6**, 251.

[16] Notes on Microscopic Sections of Limestones from Formosa, Collected by Dr Koto of Japan. *Journ. Geol. Soc. Tokyo* (1900), **7**, 1–4.

[17] On Some Fossils from the Islands of Formosa and Riu-Kiu (=Loo Choo). *Journ. Coll. Sc. Imp. Univ. Tokyo* (1902), **17**, article 6.

avec 1 millimètre d'épaisseur; les auteurs indiquent la coexistence de formes micro-et mégasphériques.

Dans leur mémoire sur le genre *Lepidocyclina,* MM. Paul Lemoine et Robert Douvillé [18] ont décrit quelques formes provenant de Madagascar et de l'Afrique orientale allemande; ces gisements se rattachent étroitement à ceux des îles de la Sonde et font certainement partie du même bassin. Je laisse de côté parmi les espèces citées, *L. mantelli,* dont l'attribution principalement fondée sur des coupes axiales semble bien douteuse; *L. raulini* insuffisamment caractérisée et *L. morgani;* deux espèces nouvelles doivent être examinées de plus près: (16) *Lepidocyclina joffrei* est représentée par une coupe équatoriale et une coupe axiale et caractérisée surtout par la grandeur du nucleus qui atteint 2 millimètres; elle est considerée par les auteurs comme une simple race de la *L. dilatata;* les caractères des logettes latérales et des piliers ne sont pas indiqués; d'après les auteurs la surface serait lisse. Cette espèce aurait besoin d'être étudiée à nouveau.

La deuxième forme (17) *L. gallienii* ressemble beaucoup à L. *dilatata,* mais, disent les auteurs, les coupes montrent des loges environ deux fois plus petites linéairement, et séparées par de petits piliers fins (ce qui est parfaitement exact) mais un peu plus gros que ceux de *L. dilatata* (ce qui n'est vrai que pour les piliers que l'on observe sur les bords dans cette dernière espèce, ceux du milieu étant au contraire beaucoup plus gros.) Néanmoins les auteurs ont parfaitement saisi le caractère principal de cette espèce, caractère du reste commun avec presque toutes les formes de l'Extrême Orient d'avoir les logettes bien plus petites que les espèces de la région méditerranéenne.

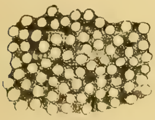

FIG. 7.—*Lepidocyclina gallienii* de Madagascar; coupe près de la surface montrant la disposition des piliers, gr. 20 fois.

J'ai sous les yeux le type de l'espèce: la surface extérieure polie montre des logettes très arrondies ayant en moyenne 0.1 millimètre de diamètre séparées par des cloisons épaisses avec de nombreux piliers aux points de croisement de ces cloisons, quadrangulaires, pentagonaux ou hexagonaux ayant à peu près la même largeur que les cloisons. Ces piliers couvrent à peu près toute la surface de la coquille à l'exception de la zone marginale.

On voit que cette forme est très voisine de (2) *L. carteri;* les dimensions des logettes sont analogues, mais dans cette dernière espèce les piliers paraissent moins développés.

Plus récemment M. Warren D. Smith a publié une série de travaux très importants sur la géologie des Philippines; il a décrit et figuré plusiers espèces de Lépidocyclines.

[18] *Mém. Soc. géol. de France,* Paléontologie, (1904), 12, n° 32.

En 1906 il a étudé les Orbitoïdes de Binangonan.[19] Cette localité avait été signalée par Richthofen,[20] qui disait y avoir recueilli une grande quantité de Nummulites de diverses grosseurs et appartenant à plusieurs espèces. M. Warren D. Smith n'y a trouvé que des Lépidocyclines: il décrit et figure sous le nom de (18) *Orbitoïdes richthofeni* (loc. cit., Pl. I, fig. 1) une espèce de grande taille qui devait atteindre 36 millimètres de diamètre avec une épaisseur maxima de 8 millimètres. L'auteur a bien voulu me communiquer la preparation figurée: c'est une section oblique et ne passant pas par le centre, comme le montre l'inégalité des deux moitiés, de part et d'autre du plan équatorial. Au milieu du côté le plus large on distingue un élément de coupe tangentielle (c'est à dire perpendiculaire au rayon) dans laquelle on voit que les logettes sont séparées par des cloisons très épaisses; c'est un caractère que l'on ne retrouve que dans le groupe de la *Lep. formosa.* D'un autre côté l'échantillon est partiellement dissous dans la region périphérique, les piliers plus résistants devraient être conservés; or il font défaut, ce qui indique qu'il n'en existait probablement pas. On peut chercher à se rendre compte de l'épaisseur des cloisons par leur largeur minima dans la coupe, elle est environ la moitié de celle des logettes. Ces caractères indiquent bien une espèce du groupe de *L. formosa,* mais la forme générale parait assez différente, l'échantillon étant beaucoup moins globuleux. Il serait donc nécessaire d'examiner d'autres échantillons pour préciser les caractères de l'espèce.

La figure 2 de la même planche reproduit la section d'un autre échantillon bien plus voisin par sa forme et l'ensemble de ses caractères de *L. formosa.*

Peu après le même auteur[21] publiait la description d'une série de fossiles provenant également de l'île de Luzon, mais au Sud de Manille. Dans cette région le Miocène à *Vicarya callosa* repose directement sur des roches éruptives; il signale dans ces couches et décrit sous le nom de (19) *Orbitoïdes martini* une Lépidocycline (loc. cit., p. 628, Pl. IV, fig. 6, 7, 8) de forme lenticulaire dont le diamètre varie de 15 à 50 millimètres. J'ai entre les mains la coupe axiale (fig. 8), elle ne montre pas de piliers nets, mais seulement des parois de loges un peu épaissies.

L'auteur dit que des formes analogues sont abondantes dans les calcaires de Cebú; je serai en effect porté à en rapprocher les échantillons de la vallée de Cumajumayan (éch. n° 285). Mais comme le nom de *L. martini* a déjà été employé en 1900 par Schlumberger, il ne peut être conservé.

[19] *This Journal* (1906), 1, 203.

[20] Ueber das workommen von Nummulitenformation auf Japan und den Philippinen. *Ztsch. deutch. Geol. Ges.,* (1862), 14, 357.

[21] Preliminary Geological Reconnaissance of the Loboo mountains of Batangas Province. *Ibid* (1906), 1, 617.

Tout récemment des travaux importants ont été publiés en Italie sur des Foraminifères recueillis par le Dr Bonarelli dans les îles de la Sonde.

C'est d'abord un mémoire de Melle Giuseppina Osimo [22] sur des Foraminifères de Dongola, sur la côte occidentale de Celebes, à l'entrée de la baie de Palos. Parmi les formes figurées et décrites par l'auteur je signalerai une série de petites ou très petites Nummulites à filets rayonnants parmi lesquelles *N. elegans,* d'après laquelle l'auteur attribue ce niveau au Bartonien; *Amphistegina niasi* et deux Lépidocyclines: *L. tournoueri* et une forme nouvelle (20) *Lepidocyclina provalei,* représentée par un seul exemplaire de 7 a 8 millimètres de diamètre et une épaisseur d'environ 5 millimètres. Toute la surface est couverte de granulations saillantes de grosseur croissante de la périphérie vers le centre, où elles atteignent 0.2 millimètre; elles sont séparées d'après l'auteur par une seule rangée de logettes. Cette disposition rappelle tout à fait celle de *L. ngembaki,* mais ici les piliers sont moins uniformes et atteignent au centre une grosseur presque double.

Immédiatement après, le même recueil a publié deux mémoires de Mlle Irène Provale [23] sur des Foraminifères de Bornéo recueillis également par le Dr Bonarelli. Ils proviennent de différentes localités, et l'auteur distingue plusiers niveaux différents: un niveau inférieur à petites Nummulites et à *Orthophragmina* attribué a l'Eocène supérieur, un niveau moyen à *Lépidocyclina schlumbergeri, raulini, tournoueri* et à *Nummulites fichteli* représentant l'Oligocène et un niveau supérieur miocène à petites Lépidocyclines. Il est peu probable que les Lépidocyclines du niveau moyen soient identiques aux espèces de France dont l'auteur les rapproche; en particulier les figures données de *L. raulini* indiquent une forme à logettes bien plus petites, mais les descriptions sont insuffisantes pour déterminer leurs affinités réelles.

Dans la deuxième partie l'auteur figure une *Lep. formosa* certainement analogue au type, mais en différant par sa forme bien moins globuleuse, et une *L. insulæ-natalis,* espèce à laquelle il rapporte le *L. ngembaki* de Schlumberger et *L. provalei* de Mlle Osimo.

Ces deux dernières espèces sont en effet très voisines comme je viens de l'indiquer, mais elles sont très différentes du *L. insulæ-natalis* (8) comme je l'ai fait voir précédemment. Du reste l'échantillon figuré sous ce nom (Pl. III, fig. 4, 5, 6) est extrêmement globuleux et rappellerait plutôt *L. sumatrensis.*

Une curieuse espèce nouvelle est (21) *L. ferreroi* qui avait été recueillie il y a déjà longtemps à Sumatra par M. Verbeek et à Madagascar

[22] Di alcuni Foraminiferi dell'eocene superiore di Celebes. *Rivista italiana di Paleontologia,* Anno XIV (1908), 28–54, Pl. I–III.

[23] Di alcune Nummulitine e Orbitoidina dell' isola di Borneo, deux parties. *Rivista italiana di Paleontologia,* Anno XIV (1908), 55–80, Pl. IV–VI et Anno XV (1909), 65, Pl. II, III.

par M. Lemoine. Elle est caractérisée par 3, 4 ou 5 grosses pustules saillantes placées à une certaine distance du centre.

Il faut signaler encore plusieurs variétiés de *Lep. tournoueri* à rapporter probablement à *Lep. verbeeki:*

1. Var. *angulosa* (22) (loc. cit., Pl. II, fig. 13, 14, 15), caractérisée par 5 grosses pustules disposées en couronne autour du centre: paraît voisine de *L. angularis* (15) de Newton et Holland.

2. Var. *inflata* (23) (loc. cit., Pl. III, fig. 14, 15) avec une grosse pustule au centre.

3. Var. *borneënsis* (24) (loc. cit., fig. 16–19) avec les granules uniformément répartis sur la surface et un nucleus souvent irrégulier et pluriloculaire.

*Résumé.*—Il resulte de cette longue révision qu'un assez grand nombre d'espèces de Lépidocyclines provenant des Indes Orientales [24] ont déjà été décrites par les différents auteurs; certaines formes ont été rapprochées des espéces d'Europe, tandis que d'autres ont été considérées comme spéciales. Une étude attentive montre presque toujours que les espèces indiennes sont différentes des formes européennes; en particulier le réseau est ordinairement à mailles notablement plus petites; ce caractère signalé par MM. Lemoine et R. Douvillé pour des formes de Madagascar paraît se retrouver dans toutes les espèces des Indes orientales. Il semble donc préférable d'être très réservé dans ces assimilations. Mais si ces deux groupes de formes sont différents, elles forment en réalité deux séries parallèles et constituées par des espèces correspondantes, c'est à dire présentant le même degré d'évolution.

J'ai précédemment groupé les espèces de Lépidocyclines en deux sections: *Eulepidina* et *Nephrolepidina* fondées sur la forme des loges équatoriales (en spatule ou en ogive) et sur la disposition du nucléus (deuxième loge embrassante ou réniforme) ; je vais examiner successivement les espèces qui ont été distinguées dans chacun de ces groupes.

Dans les *Eulepidina* les caractères les plus précis sont donnés par la disposition des piliers; il est facile de se rendre compte que ces derniers prennent naissance aux points de rencontre des cloisons des logettes équatoriales; les premières couches des logettes latérales correspondent aux logettes équatoriales et sont par suite à peu près hexagonales; on distinguerait alors sur leur pourtour 6 ébauches de piliers; chacun d'eux ayant une section triangulaire. Mais les piliers se développent inégalement tandis que les logettes se déforment plus ou moins rapidement. Dans les formes les moins évoluées les piliers restent polygonaux à 3.4 ou 5 côtés; ils forment une ceinture discontinue autour de chaque logette,

[24] Je comprends sous cette denomination l'ensemble des îles en bordure du continent depuis Madagascar jusqu'au Japon et les portions du rivage qui s'y rattachent au point de vue géologique.

c'est le stade n° 1. Presque toujours les piliers se développent davantage dans la partie médiane ordinairement renflée, mamillée, ils se rejoignent alors assez souvent et entourent plus ou moins complètement les logettes, c'est le stade n° 2.

Dans un troisième cas les piliers qui se développent sont moins nombreux et restent isolés tout en étant encore polygonaux à 3.4 ou 5 côtés (stade n° 3).

Enfin ils peuvent prendre une importance plus grande et autour de chacun d'eux on distingue une sorte de rosette formée de nombreuses logettes; on dit alors que les piliers sont devenus des pustules (stade n° 4). Cette disposition peut se développer seulement dans le mamelon central ou envahir une partie plus ou moins grande de la surface de la coquille.

D'une manière générale une même section tangentielle oblique pourra montrer en se dirigeant de la couche équatoriale vers le centre les différents stades de développement des piliers, et c'est d'ordinaire au centre que ceux-ci seront le plus spécialisés.

Une disposition toute différente se rencontre dans certaines espèces où toutes les cloisons s'épaississent sans former de piliers proprement dits (stade n° 5).

Exceptionnellement les piliers peuvent ne pas se développer et manquer complètement. Nous distinguerons cette disposition comme stade n° 0.

D'après ces considérations on peut distinguer parmi les espèces déjà connues:

1° *Lepidocyclina carteri* Martin (2.1880) caractérisé par le stade n° 1, nombreux petits piliers a 3, 4, ou 5 côtés. La coquille est mince, à peine renflée au centre où les piliers ne présentent pas de développement spécial. On sait que les couches latérales sont minces et très nombreuses.

2° *Lepidocyclina gallienii* Lemoine et R. Douvillé (17.1904) présente comme l'espèce précédente de très nombreux piliers à 3.4 ou 5 côtés. Ils sont un peu plus développés, les cloisons sont plus épaisses et les logettes latérales plus arrondies; mais ces différences ne sont guère que des différences de races. En outre il n'était pas possible de s'en rendre compte au moment où l'espèce de Madagascar a été établie, le *L. carteri* étant très incomplètement défini.

3° *Lepidocyclina insulæ-natalis* J. et Ch. (8.1900); les piliers sont plus développés et viennent se rejoindre partiellement en formant autour des logettes une ceinture plus ou moins discontinue (stade n° 2); c'est au centre qu'ils atteignent leur développement maximum.

Les trois espèces qui précèdent et en particulier la dernière correspondent par la forme et le développement de leurs piliers à *L. dilatata,*

Mich. d'Europe; elles n'en diffèrent guère que par la plus grande finesse du réseau.

4° *Lepidocyclina gigantea* Martin (3.1880); les piliers sont moins nombreux, isolés les uns des autres et forment presque des pustules, séparés souvent par plusieurs rangées de logettes (stade n° 3); c'est une disposition qui rappelle celle de *L. elephantina* Mun. Chalm.

5° *Lepidocyclina provalei* Osimo (20.1908); les pustules sont ici nettement caractérisées et elles sont séparées par une seule rangée de logettes; leur grosseur augmente progressivement quand on se rapproche du milieu de la coquille.

6° *Lepidocyclina ngembaki* Schlumberger (12.1900) présente également des pustules bien caractérisées quoique très petites; elles sont séparées au moins au centre par une seule rangée de logettes, et elles sont de grosseur uniforme, ce qui distingue cette espèce de la précédente.

7° *Lepidocyclina formosa* Schlumberger (14.1902) se distingue de toutes les formes précédentes par l'épaisseur de ses cloisons, et l'absence de véritables piliers.

Dans les *Nephrolepidina* les pustules existent presque toujours, mais leur disposition fournit de bons caractères.

8° *Lepidocyclina verbeeki* N. et H. (6.1899), est la forme fondamentale correspondant à *L. tournoueri* Lem. et R. D., d'Europe. C'est comme cette dernière une forme mégasphérique et elle s'en distingue par son réseau beaucoup plus fin; il suffit pour s'en rendre compte de comparer les figures 8 de Newton et Holland [25] et 1 de Lemoine et Rob. Douvillé,[26] qui représentent les coupes équatoriales de ces deux espèces à un grossissement analogue, 20 et 18 fois.

Cette espèce présente de nombreuses pustules dont la grosseur va en croissant de la périphérie au centre.

On pourrait distinguer par des noms spéciaux les formes suivantes:

9° *Lepidocyclina inflata* Provale (23.1909) caractérisée par une très grosse pustule médiane.

10° *Lepidocyclina angularis* Newton et Holland (15.1902) présente une couronne de grosses pustules plus développées que les pustules médianes. Elle correspond à peu près au *Lep. morgani* d'Europe.

11° Enfin une forme très particulière est *Lep. ferreroi* Provale (21.1908) dont la surface présente seulement 3 à 5 gros boutons saillants disposés en étoile autour du centre qui est déprimé.

Nous pouvons maintenant aborder l'examen des échantillons des Philippines, il sera facile de distinguer les formes suivantes:

[25] *Ann. & Mag. Nat. Hist.* (1899), VII, 3, pl. 9.

[26] *Mem. Soc. géol. Fr., Paléontologie* (1904), 12, Pl. III.

A. Section des **Eulepidina**.

1° Formes grandes, minces ou lenticulaires, avec mamelon central plus ou moins développé.

**Lepidocyclina insulæ-natalis**, J. et Ch. Pl. B, figs. 1, 2, 3.

*Orbitoïdes* (*Lepidocyclina*) *insulæ-natalis* R. Jones et Chapman, in Andrew's Christmas Island (1900), 242, Pl. XX, fig. 5, non Schlumberger.

*Orbitoïdes* de grande taille, atteignant 32 millimètres de diamètre, minces, à peine mamillés au centre. La surface est couverte de petites granulations ayant de 0.15 à 0.20 millimètre de diamètre, quadrangulaires ou pentagonales. Dans la partie centrale, elles arrivent souvent à se toucher et elles entourent alors les logettes. C'est bien là le caractère de cette espèce comme il a été indiqué précédemment.

*Localités*. Cette espèce a éte recueillie au Barrio de Mesaba (Cebú, n° 272) (figs. 1, 2), une variété (fig. 3) provient de Guila-Guila (Cebú, n° 278) où elle est associée aux espèces suivantes; une coupe mince de cette dernière forme communiquée par M. Warren D. Smith a été reproduite Pl. A, fig. 7, avec un grossissement de 10 fois.

**Lepidocyclina richthofeni** Warren D. Smith. Pl. C, figs. 1, 2, 3.

*Lepidocyclina richthofeni* Warren D. Smith, Philip. Journ. Sci. (1906) 1, 203.

J'ai indiqué plus haut les caractères assez peu précis de cette espèce: forme lenticulaire, logettes latérales séparées par des cloisons épaisses et absence de piliers ou piliers peu développés. Je réserverai cette dénomination pour les formes voisines de l'espèce précédente, mais avec peu ou point de piliers.

On retrouve ces caractères dans les échantillons de la vallée de Cumajumayan (Pl. C, fig. 3) (Cebú, n° 285) ; ils sont lenticulaires, mais moins gros que le type, qui est du reste indiqué comme le plus grand échantillon trouvé à Binangonan; leur diamètre ne paraît pas dépasser 25 millimètres avec une épaisseur de 6 millimètres. Les piliers sont peu développés et seulement dans la partie moyenne; vers le centre on n'observe guère que des cloisons épaissies rappellant celles de *L. formosa*. Seulement le réseau est bien plus serré et les logettes sont bien plus petites; elles se rapprochent beaucoup par leurs dimensions de celles des espèces précédentes.

Des échantillons très analogues ont été recueillis près de la mine de Compostela (Cebú, n° 289).

À Guila-Guila (Cebú, n° 278) les Lépidocyclines sont de forme un peu différente; elles sont généralement minces et assez fortement mamillées: les unes (Pl. C, fig. 2) ont seulement 20 à 22 millimètres de diamètre et présentent autour du mamelon central assez large un disque

épaissi de 18 millimètres de diamètre, au delà duquel la coquille s'amincit brusquement comme dans certains *Orthophragmina* (*O. bartolomei* Schlm.). Le réseau superficiel est très fin, les piliers sont à peine marqués et les cloisons séparatives sont épaissies.

D'autres échantillons, et ce sont les plus nombreux (Pl. C, fig. 1, 1b), sont plus grands et plus minces; ils atteignent 38 millimètres de diamètre, sont mamillés au centre où leur épaisseur est de 3.5 millimètres. La partie moyenne présente quelques piliers analogues à ceux de l'espèce précedente; mais au centre les piliers disparaissent et les cloisons sont plus ou moins épaissies. Ce caractère les distingue du *L. insulæ-natalis,* où les piliers sont au contraire plus développés dans la partie centrale.

2° Formes globuleuses avec collerette équatoriale.

**Lepidocyclina formosa** Schlumberger. Pl. D, figs. 2, 3, 4, et 5.

*Lepidocyclina formosa* Schlumberger, Samml. d. Geol. r. museums in Leiden, (1900), I, 6, fasc. 3, 128.

Espèce de grandeur moyenne atteignant un diamètre probablement supérieur à 12 millimètres lorsque la collerette est bien entière. La partie centrale est globuleuse, presque sphérique; elle mesure ordinairement 6 millimètres de diamètre avec une épaisseur de 4.5 à 6 millimètres. Au delà le bord s'amincit brusquement et forme dans la région équatoriale une sorte de collerette toujours plus ou moins brisée; la plus grande largeur que j'ai observée est de 3 millimètres, mais celle-ci devait-être notablement plus grande (Pl. D, fig. 1 et 2).

Cette espèce est nettement caractérisée par l'épaisseur des cloisons qui entourent les logettes latérales; la surface paraît lisse et les piliers semblent faire défaut ainsi que les granulations superficielles qui leur correspondent (Pl. D, fig. 3). L'épaisseur des cloisons peut atteindre 0.15 à 0.20 millimètre pour un diamètre de logettes légèrement supérieur. On observe du reste d'assez grandes variations dans ces dimensions et d'ordinaire les logettes sont plus grandes vers le milieu de la coquille.

*Localités.*—Cette espèce est très abondante près de la mine de Compostela (Cebú, n° 287) où elle est associée à *Lep. richthofeni* et à l'espèce suivante; elle a également été recueille à Guila-Guila (Cebú n° 278) où elle accompagne les variétés plates de l'espèce précédente.

**Lepidocyclina inermis** sp. nov. Pl. D, fig. 5.

On recontre près de la mine de Compostela des échantillons ayant la même forme que *L. formosa,* globuleux et bordés d'une collerette. Ils sont dépourvus de piliers comme cette espèce, mais les cloisons sont toujours minces; ils correspondent au stade n° 0, défini plus haut.

B. Section des **Nephrolepidina.**

Formes petites, lenticulaires, plus ou moins renflées; logettes ogivales; deuxième loge réniforme.

**Lepidocyclina smithi** sp. nov.

Les calcaires a Nummulites de l'île de Batan renferment des Orbitoïdes de 3 à 5 millimètres de diamètre, qui ne sont guère connues que par leurs sections. J'ai pu cependant isoler une de ces formes qui présente les caractères des *Nephrolepidina*.

Elle a 4 millimètres de diamètre et à sa surface on distingue 4 très grosses pustules qui viennent presque se rejoindre en laissant seulement entre elles 4 trainées de logettes qui dessinent une sorte d'X. En usant progressivement l'une des faces j'ai pu constater que les pustules en se rapprochant du plan équatorial, prenaient leur forme ronde habituelle. La couche équatoriale présente les logettes rhomboïdales caractéristiques. C'est une forme microsphérique.

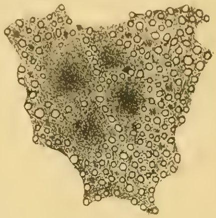

FIG. 8.—*Lepidocyclina smithi*; coupe près de la surface parallèle au plan équatorial, montrant le grand développement des quatre piliers médians, gr. 20 fois.

Cette Lépidocycline provient d'une couche de calcaire intercalé dans le systême lignitifère (échantillon n° 2).

Une préparation d'un calcaire de l'île de Batan (baie de Calanaga n° 4) dans lequel on observe de nombreuses *Nummulites* à test noir, montre la section verticale d'un *Orbitoïdes* avec 2 grosses pustules d'un côté et une de l'autre, mais c'est mégasphérique. C'est peut-être la forme A correspondant à l'espèce précédente.

Le type très particulier que je viens de décrire correspond à certaines variétés de la *L. præmarginata* d'Europe. Elle se distingue de cette espèce par ses 4 grosses pustules très rapprochées; elle rappelle également *L. ferreroi*, mais dans cette dernière les pustules sont beaucoup plus éloignées et donnent à la coquille une forme étoilée.

**Lepidocyclina verbeeki** N. et H. Pl. D, fig. 8.

*Orbitoïdes papyracea* Brady, Geol. Mag. Dec. II (1875), 532, Pl. XIV, fig. 1, non Boubée.

*Lepidocyclina verbeeki* Newton et Holland, Ann. & Mag. Nat. Hist. (1899), VII, 3, 257, Pl. IX, fig. 7, Pl. X, fig. 1.

Les formes types caractérisées par quelques pustules de grandeur moyenne sont assez rares. La figure 8 reproduit un de ces échantillons partiellement engagé dans la roche. Il provient du Calcaire blanc

supérieur de Cotabato Valley (île de Cebú, n° 279) où il est associé à la forme suivante et aux *Miogypsina.*

**Lepidocyclina inflata** Provale. Pl. D, fig. 6 et 7.

*Lepidocyclina tournoueri* var. *influta Provale,* Riv. italiana in Paleontologia, Ann. XV (1909), 73, Pl. III, figs. 14, 15.

C'est une forme voisine de la précédente, mais qui s'en distingue par une très grosse pustule centrale, tantôt seule, tantôt entourée de pustules plus petites. C'est de beaucoup l'espèce la plus fréquente dans les calcaires blancs supérieurs de l'île de Cebú. C'est peut-être une simple variété de l'espèce précédente. Ce groupe de formes mégasphériques représénte dans la province orientale celui du *Lep. tournoueri,* dont il se distingue par ses logettes équatoriales plus petites.

**Lepidocyclina** cf. **marginata** Mich.

*Nummulites marginata* Michlotti, Saggio Storico dei rizopodi caratteristici dei terreni Sopracretacei (1841), 45, Pl. III, fig. 4.

*Lepidocyclina marginata* Lem. et. R. Douv., Sur le genre Lepidocyclina, Mem. Soc. geol. Fr. Paleont. (1904), 12, 16; Rob. Douvillé, Sur des Lepidocyclnes nouvelles. Bull. Soc. géol. Fr. (1907), IV, 7, 307, Pl. X, figs. 7, 11, 12.

Les formes précédentes mégasphériques sont accompagnées d'une forme plus rare, un peu plus grande et microsphérique; elle présente de nombreuses pustules peu saillantes séparées par des logettes à parois épaisses et son diamètre atteint 7 millimètres. Mais les matériaux à ma disposition étaient insuffisants pour en permettre une description complète, et je l'ai considérée provisoirement comme une race du *Lep. marginata.*

## Genre MIOGYPSINA.

**Miogypsina irregularis,** race **orientalis.** Pl. D, fig. 9 et 10.

*Nummulites irregularis* Michelotti, Saggio Storico die rizopodi caratteristici dei terreni Sopracretacei (1841), 45.

*Miogypsina irregularis* Sacco, Bull. Soc. belge de Géologie, (1893), 7.

*Flabelliporus orbicularis* Dervieux, Atti d. R. Acad. delle Scienze di Torino, (1893), 29.

*Miogypsina irregularis* Schlumberger, Bull. Soc. géol. de France (1900), III, 28, 328, Pl. II, figs. 1 à 7.

Cette forme est abondante dans les calcaires blancs supérieurs de l'île de Cebú; elle est très voisine de l'espèce d'Europe dont elle diffère seulement par ses gros granules plus espacées et occupant une plus grande partie de la surface.

Quelques échantillons plus petits ont été trouvés dans les calcaires tendres jaunâtres de Gaba Bay (île de Batan, n° 8) situés bien au dessus des couches charbonneuses; ils sont associés au *Cycloclypeus* et à des Amphistégines.

### Genre AMPHISTEGINA.

Très commun dans toutes les couches.

**Amphistegina niasi** Verbeek.

*Nummulites Niasi* I Verbeek, Verbeek et Fennema, Descr. geol. de Java et Madoura (1896), 1155, Pl. IX, figs. 120–122.

Dans les calcaires à Nummulites du système charbonneux de l'île de Batan.

**Amphistegina** cf. **mamillata** d'Orbigny.

Espèce de petite taille, ayant environ 1.5 millimètre de diamètre; le côté visible ressemble tout à fait à la figure qui a été donnée par Carpenter (Intr. pl. XIII, fig. 23); les différences dans le mode de terminaison des loges de la face inférieure tiennent peut-être à un meilleur état de conservation.

*Localité.*—Couche à *Cycloclypeus communis* de l'île de Batan (Gaba bay).

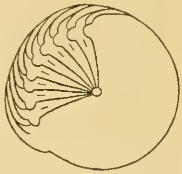

FIG. 9.—*Amphistegina cf. mamillata*, del' île de Batan, gr. 20 fois.

### RÉSUMÉ ET CONCLUSIONS.

D'après l'étude qui précède on peut classer de la manière suivante les échantillons communiqués:

I. *Terrain éogène* (comprenant l'éocène et l'oligocène) Stage *Stampien.*

Calcaire de Caracaran (île de Batan,[27] éch. n° 2).

C'est un calcaire gris bleuâtre, sur lequel les Foraminifères se détachent en noir; il fait partie du système lignitifère et il est indiqué comme intercalé entre les couches de lignite.

Les plaques minces et les sections polies ont montré de petites Nummulites de 2.7 millimètre de diamètre, qui paraissent correspondre à *N. niasi* Verbeek; mais cette dernière espèce étant microsphérique, celle des Philippines, qui est mégasphérique, a du être distinguée comme *N. subniasi.* Le même calcaire renferme montre *Amphistegina niasi* Verbeek, *Polystomella* sp. et une curieuse *Lepidocyclina* de la section des *Neophrolepidina, L. smithi,* qui rappelle certaines variétés du *L. proemarginata.*

La coexistence des *Nummulites* et des Lépidocyclines caractérise le Stampien; il est à remarquer que ces deux genres ne sont représentés ici que par des formes de très petite taille, tandis qu'un peu plus au sud, à Bornéo, les grandes formes abondent.

II. *Terrain Néogène* (aquitanien, burdigalien, helvétien, etc.) Etage *Aquitanien.*

[27] The Coal Deposits of Batan Island par Warren D. Smith, 1905 (Bull. No. 5, the Mining Bureau, Manila).

1° Grès tendre jaunâtre de Sibud Gulch (old Alpaco Mine, île de Cebú,[28] éch. n° 273).

La roche est d'une faible dureté et le ciment calcaire est très peu abondant; les fossiles y sont à l'état d'empreintes et les caractères internes sont très difficiles à reconnaître. La faune se compose essentiellement d'*Orbitolites* et d'*Alveolinella;* il faut ajouter *Operculina costata,* var. *tuberculata, Rotalia, Polystomella.* Cette couche est indiquée comme supérieure au système lignitifère et inférieure aux calcaires à Lépidocyclines. Elle serait ainsi à peu près au niveau des couches à *Orbitolites* et *Alveolinella* de Java que M. Verbeek place dans son étage m, c'est-à-dire dans l'Aquitanien inférieur. Mais par suite de la conservation insuffisante des fossiles, cette attribution doit être considerée comme seulement provisoire. Il faut ajouter que M. le professeur Martin a signale [29] des *Orbitoïdes* trouvées par Semper dans une marne d'Alpaco.

2° Le niveau le mieux caractérisé est celui des calcaires à grandes Lépidocyclines:

Calcaire de Guila-Guila (Cebú, n° 278); il renferme de nombreuses Lépidocyclines de grande taille; les unes présentant des tubercules bien développés sur toute leur surface, ont été rapportées à *L. insulæ-natalis,* tandis que les autres, dépourvues de tubercules ont été assimilées à *L. richthofeni;* ces deux formes sont du reste très voisines; elles sont associées à une troisième espèce beaucoup plus petite, composée d'une partie centrale très renflée bordée par une sorte de collerette; c'est la *L. formosa,* dépourvue de tubercules, mais présentant entre les logettes des cloisons très épaisses. Ces diverses formes se trouvent assez souvent dégagées.

Il faut places au même niveau les calcaires du Barrio de Mesaba (Cebú, n° 272), avec *L. insulæ-natalis,* ceux de la vallée de Cumajumayan (Cebú, n° 28) avec *L. richthofeni* et *L. formosa* et deux qui affleurent près de la mine de Compostela (Cebú, n° 289) avec ces deux mêmes espèces et une troisième voisine de *L. formosa* mais ne présentant entre les logettes que des cloisons minces, c'est *L. inermis.*

3° Il faut placer probablement à un niveau un peu plus élevé, un échantillon de calcaire tendre d'une couleur blanc-crême recueilli dans les grands escarpements, le long de la route de Toledo (Cebú) sur les bords de la rivière Minanga (éch. n° 277, près du Camp n° 1); il présente sur sa surface des échantillons bien conservés d'*Operculina complanata* et de *Cycloclypeus communis;* cet échantillon rappelle les marnes à Silex de l'Aquitanien de Bornéo.

Etage *Burdigalien.*

[28] Cebú Island par Warren D. Smith. *This Journal* (1906), 1, 1043. The Geology of the Compostela Danao Coal Field, par le même, *Ibid. Sec. A,* (1907) 2, 377.

[29] Orbitoïdes von den Philippine, *Centralbl. f. Mineral., Geol. u. Paläon.* (1901), 326.

Ce niveau supérieur est caractérisé par l'apparition des *Miogypsina* et l'abondance des petites Lépidocyclines du groupe de *L.* (*Nephrolepidina*) *verbeeki*. Je lui rapporte les deux échantillons suivants:

Un calcaire sableux jaunâtre, très tendre de Gaba Bay, dans l'île de Batan (éch. nº 8), indiqué comme affleurant bien au dessus du système lignitifère; il renferme des Foraminifères bien conservés, mais très fragiles, parmi lesquels *Globigerina, Cycloclypeus communis, Amphistegina* cf. *mamillata*, et de petits *Miogypsina*, ces derniers rappelant tout à fait les formes du Burdigalien des environs de Dax.

Un calcaire blanc assez tendre, qui couronne la Cordillère centrale de l' île de Cebú, dans la Vallée de Cotabato (éch. nº 279) : il renferme *L. verbeeki*, déjà signalé par M. Warren D. Smith, mais surtout *L.* inflata associé à de nombreuses *Miogypsina irregularis*.

Des trois faunes que je viens de signaler, la seconde caractérisée principalement par l'abondance des grandes Lépidocyclines a une extension considérable depuis Madagascar jusqu'aux Philippines. J'ai fait voir dans mon Etude sur les Foraminifères du Tertiaire de Bornéo [30] qu'elle correspondait à l'Aquitanien; j'y ai distingué trois niveaux E, F, G, qu'il sera peut-être possible de retrouver aux Philippines, quand les explorations géologiques y seront plus avancées.

Le niveau supérieur Burdigalien H, présente aussi une grande extension; il est très développé dans l'île de Nias, à Java, d'où provient le type de *L. verbeeki*, et à Bornéo où je n'avais pas distingué cette espèce de la forme européenne voisine (*L. tournoueri*). Ce même niveau parait se prolonger au Nord à Formosa (Taiwan) et au Japon au environs de Tokyo. Cette dernière localité n'atteint encore que la latitude de 36°, c'est-à-dire à peu près celle de Gibraltar, tandis que les Lépidocyclines atteignent en France presque le 44e degré, et dépassent en Italie le 45e.

Le tableau suivant résume les rapprochements que je viens d'indiquer:

| Philippines. | | | Bornéo. | |
|---|---|---|---|---|
| II. | Calcaires supérieurs à petites Lépidocyclines | Lep. Verbeeki, Miogypsina<br>Cycloclypeus communis | H. | BURDIGALIEN. |
| | Calcaires moyens | Cycloclypeus communis<br>Operculina complanata | G. | AQUITANIEN. |
| | Calcaires inférieurs à grandes Lépidocyclines | Lep. insulâe-natalis | F. | |
| | | Lep. Richthofeni<br>Lep. formosa | E. | |
| I. | Systéme lignitifère et calcaire Inférieur à Nummulites | Nummulites Subniasi<br>Amphistigina Niasi<br>Lépidocyclina Smithi | D. | Stampien. |

30 *Bull. de la Soc. géol. de France*, 4 Série, t. V, p. 43.

En Europe la sucession des faunes est très analogue: les Lépidocyclines y sont très développées dès le Stampien aussi bien en Espagne qu'en Italie, elles y atteignent une grande taille et y sont associées comme à Bornéo avee des Nummulites réticulées. Le groupe du *L. dilatata* remplace le groupe Asiatique du *L. insulæ-natalis* et se prolonge dans l'Aquitanien, tandisque dans les niveaux supérieurs le groupe du *L. tournoueri* remplace celui du *L. verbeeki;* tous les deux sont associées aux *Miogypsina.*

Le bassin européen et le bassin asiatique paraissent avoir été complètement séparés dès la fin de l'Eocène par le soulèvement du Liban qui s'est développé en travers de la Mésogée et a séparé la Mediterranée de l'Océan Indien. C'est seullement à une époque beaucoup plus récente qui l'ouverture de la mer Rouge a été sur le point de rétablir, une communication entre les deux mers, mais les eaux de l'Océan Indien ont été arrêtées à quelques kilomètres de la Méditerranée devant la faible barrière de l'isthme de Suez.

TABLE DES MATIÈRES.

Alveolinella
Amphistegina
andrewsiana (Lepidocyclina)
angularis (Lepidocyclina)
angulosa (Lep. tournoueri var.)
borneënsis (Lep. tournoueri var.)
carteri (Lepidocyclina)
communis (Cycloclypeus)
complanata (Operculina)
Cycloclypeus
ephippioïdes (Lepidocyclina)
Eulepidina
ferreroi (Lepidocyclina)
formosa (Lepidocyclina)
gallienii (Lepidocyclina)
gigantea (Lepidocyclina)
Heterostegina
inermis (Lepidocyclina)
inflata (Lep. tournoueri var.)
inflata (Lepidocyclina)
insulæ-natalis (Lepidocyclina)
irregularis (Miogypsina)
joffrei (Lepidocyclina)
Lepidocyclina
mamillata (Amphistegina)
marginata (Lepidocyclina)
martini Schl. (Lepidocyclina)
martini W. Smith (Lepidocyclina)
martini (Orbitoïdes)
multipartita (Lepidocyclina)
murrayana (Lepidocyclina)
neodispansa (Lepidocyclina)
Nephrolepidina
ngembaki (Lepidocyclina)
niasi (Amphistegina)
Nummulites
Operculina
Orbitolites
Polystomella
provalei (Lepidocyclina)
radiata (Lepidocyclina)
richthofeni (Lepidocyclina)
Rotalia
smithi (Lepidocyclina)
subniasi (Nummulites)
sumatrensis (Lepidocyclina)
tournoueri (Lepidocyclina)
verbeeki (Lepidocyclina)

# EXPLICATION DES PLANCHES.

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### Planche A.

Fig. 1. *Alveolinella.* Old Alpaco Mines (Cebú, N° 273), gr. 10 fois.
2. *Orbitolites.* Même provenance, gr. 10 fois.
3. *Operculina costata* d'Orbigny. Minanga river (Cebú, N° 277), gr. 10 fois.
4. *Operculina costata* var. *tuberculata.* Old Alpaco Mines (Cebú, N° 273) gr. 10 fois.
5. *Cycloclypeus communis* Martin. Minanga River (Cebú, N° 277) gr. 10 fois.
6. *Heterostegina.* Barrio of Mesaba (Cebú, N° 272) gr. 10 fois.
7. *Lepidocyclina insulæ-natalis* J. et Ch. Guila-Guila (Cebú, N° 278) × 10, d'après une préparation de M. Warren D. Smith.

### Planche B.

Fig. 1. *Lepidocyclina insulæ-natalis* J. et Ch. Barrio of Mesaba (Cebú, N° 272). (1a) Profil en vraie grandeur; (1b) surface grossie 10 fois; le milieu vers le haut à gauche a été légerement usé.
2. Même espèce, de la meme localité, grandeur naturelle.
3. *Lepidocyclina insulæ-natalis* J. et Ch. Guila-Guila (Cebú, N° 278). (3 et 3a) En grandeur naturelle; (3b) surface du même échantillon grossie 10 fois.

### Planche C.

Fig. 1. *Lepidocyclina richthofeni* Warren D. Smith. Guila-Guila (Cebú, N° 278), grandeur naturelle. (1b) Surface du même échantillon grossie 10 fois.
2. Autre échantillon de la même provenance beaucoup plus épais et avec un commencement de collerette.
3. *Lepidocyclina richthofeni.* Cumajumayan Valley (Cebú, N° 285), détail de la surface, gr. 10 fois.

### Planche D.

Fig. 1 et 2. *Lepidocyclina formosa* Schlumberger. Compostela Mine (Cebú, N° 289). Vues de face et de profil en vraie grandeur.
3. Même espèce de Guila-Guila (Cebú, N° 278), détail de la surface gr. 10 fois.
4. Même espèce de la même localité, Section mince gr. 10 fois, d'après une préparation de M. Warren D. Smith.
5. *Lepidocyclina inermis* H. Douvillé. Compostela Mine (Cebú, N° 289) gr. 10 fois.
6 et 7. *Lepidocyclina inflata* Provale. Cotabato Valley (Cebú, N° 289), gr. 10 fois.
8. *Lepidocyclina verbeeki* Newton et Holland. Même provenance, gr. 10 fois.
9 et 10. *Miogypsina irregularis* Michelotti, race *orientalis.* Même provenance, gr. 10 fois.

FIGURES DANS LE TEXTE.

FIG. 1. *Nummulites subniasi* sp. nov. de la formation charbonneuse de l'île de Batan, gr. 10 fois.

2. *Lepidocyclina sumatrensis*, gr. 6 fois d'après la figure originale de Brady.

2bis. Section d'un echantillon de l'île de Nias, gr. 10 fois.

3. *Lepidocyclina carteri* Martin, disposition des piliers près de la surface, gr. 20 fois.

4. *Lepidocyclina gigantea* Martin, disposition des piliers près de la surface, gr. 20 fois.

5. Reproduction grossis 5 fois de la partie centrale de la figure type de MM. Rupert Jones et Chapman, le grossissement de cette dernière figure n'est pas indiqué.

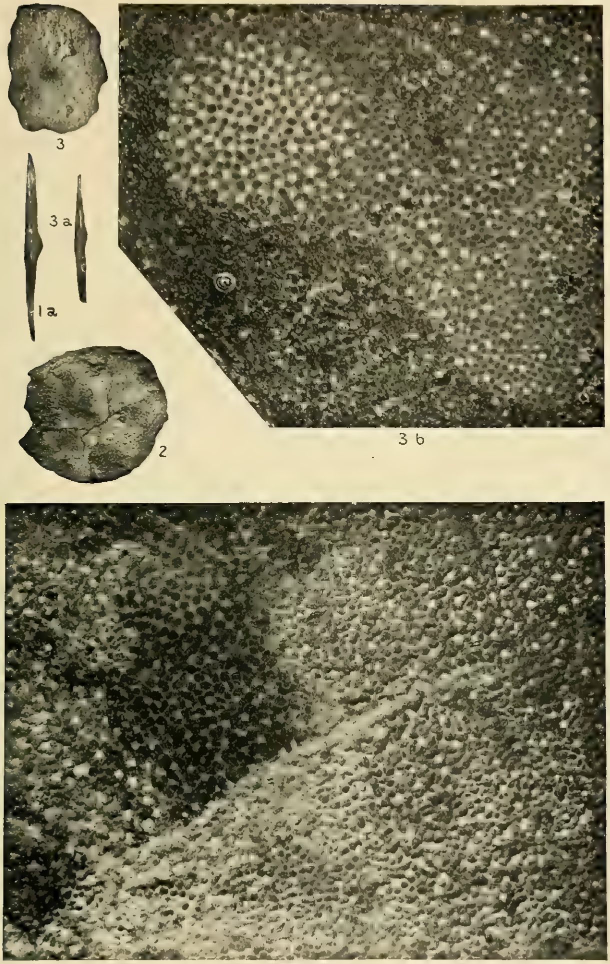
6. *Lepidocyclina formosa*, disposition des logettes sur une section de l'échantillon type de l'espèce, gr. 20 fois.

7. *Lepidocyclina gallienii* de Madagascar; coupe près de la surface montrant la disposition des piliers, gr. 20 fois.

8. *Lepidocyclina smithi;* coupe près de la surface parallèle au plan équatorial, montrant le grand développement des quatre piliers médians, gr. 20 fois.

9. *Amphistegina* cf. *mamillata* de l'île de Batan, gr. 20 fois.


PLANCHE A.



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3 a

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PLANCHE B.

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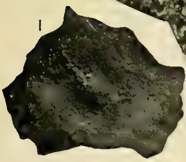

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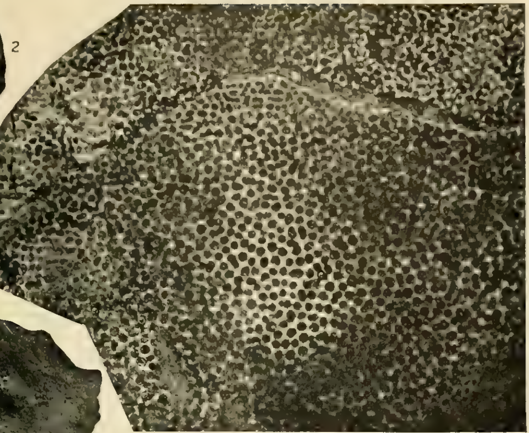

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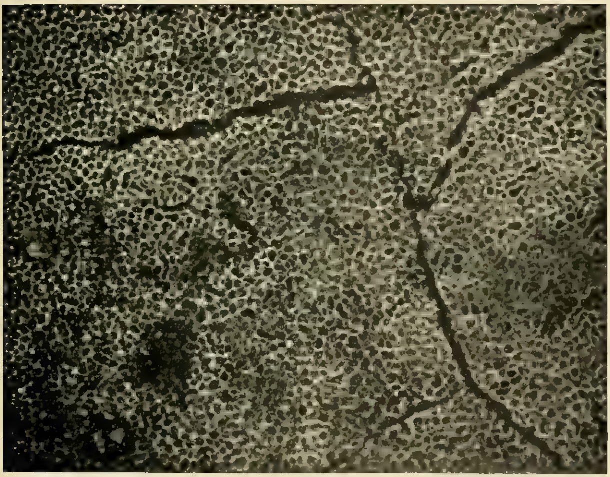

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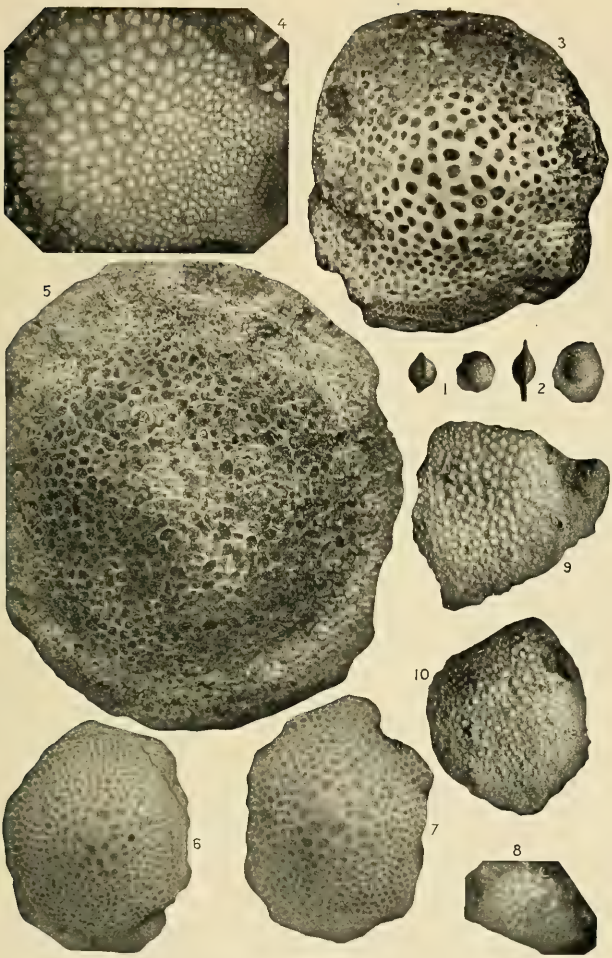


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# THE HARVEST FEAST OF THE KIANGAN IFUGAO.

By ROY FRANKLIN BARTON.

The Ifugao has some hundreds of spirits of various ranks ranging from gods to demons, monsters, imps, and spirits dwelling in trees and stones; and in addition to these, there are the souls, *linauwa*, of his ancestors, who are nearly as powerful as the other spirits. A very large share of the Ifugao's life is spent in obtaining animals and other things needed for religious feasts.

Whenever a member of the family falls ill, chickens, ducks, pigs, or a carabao, according to the wealth of the family and the seriousness of the case, are killed; one or more jars of rice wine and a quantity of betel nuts and betel leaves are provided. An enormous number of spirits, including all the spirits of the ancestors for six or seven generations, and the ancestral spirits in a direct male line from Bugan and Balitok, the survivors of a great flood, are invited by name to the feast. If an Ifugao leaves on a journey far from home; if he enlists in the Constabulary; or cuts his son's hair for the first time, he makes a religious feast. If he happens to go to Nueva Vizcaya to buy a carabao, he makes a feast to which he invites certain spirits, praying to them to put it into the mind of whomsoever he may try to buy from, to sell the animal cheap. If an Ifugao marries or is divorced; if a child is born to him; if he makes a loom; if he becomes angry with a man of another village and desires his death; if he moves into another house; if he is apparently unsuccessful in a love affair; if he finds that he is consuming his supply of rice too rapidly; if a bird called *pitpit* flies into his house; if he names his baby; if a bad debtor delays payment—a proper feast is the invariable accompaniment.

Certain feasts rank higher in importance, expense, and pretentiousness than others. The most expensive and the one which invests the giver with great prestige is the *uyaue*,[1] the feast of the *kadañgyan*, a class of rich men that approaches an aristocracy. The *kolating*, or harvest feast,

[1] In writing Ifugao words in this article, a phonetic system of spelling is used. It may be noted that the vowels have the Continental values and that the *g* is always hard.

is not very expensive; it can be given for from fifteen to twenty pesos; it is not pretentious, for every one who has a few rice fields gives it; but it is of the greatest importance.[2] When the meaning of rice to the Ifugao is considered, it is not strange that harvest time should be celebrated by feasts having profound religious importance. A bad rice crop indicates that the spirits have a "bad mind" toward the village and special effort must be made to appease them to the end that further disasters may be averted. A good rice crop is an occasion for a thank offering, and for a feast to keep the spirits right during the coming year.

Every man who owns a granary, *alang,* must give a ceremonial feast, *baki.*[3] If his granaries are located in different places, the man must give a feast at each. These have a fourfold function: First, to thank the deities, *bagol,* for the crop of the past year if it has been good, or to reprove them gently and argue the case with them if it has been a bad one; second, to persuade the deities to increase the rice as it is being cut and stored in the granary; third, to induce them not to decrease the rice nor to destroy it during the year, as, for example, by strong winds that can break granaries, or by lightning; and fourth, to put the deities in a "good mind," that they may favor the general welfare of the village during the year to come, that they may make sickness rare, prevent destructive storms, defeat enemies should enemies come, frustrate the designs of sorcerers in other villages, and make women, pigs, and chickens fertile.

The second function of the harvest feast, to persuade the deities to increase the rice as it is being cut and stored, is especially interesting. The idea seems absurd, but it must be considered that these people have no experience contrary to this belief; for, even if they count the *manojos*[4] of rice, *butek,* when they put them in the granary,[5] they do not keep track of the number taken from the granary for daily use. The Igorots of Lepanto also believe that the divinities may increase the rice as it is being cut and stored away. But the most intelligent Ifugaos deny the belief in this form. They believe that the divinities may make

[2] In this paper the writer desires to be understood as speaking of the Ifugaos who live in the village of Kiangan. The customs and practices of the various divisions of the Ifugao tribe vary somewhat and this article would be inaccurate did it pretend to apply to the Ifugaos as a whole.

[3] *Baki* is the general term for a religious feast. All feasts of the Ifugaos have some religious significance.

[4] Small hand sheaves of headed rice. From the Spanish *manojo,* a bundle of herbs or other plants that can be held in the hand.

[5] Counting the *manojos* is, except in the case of a field that is let to a renter, tabooed on the ground that the *bagol* will not miraculously increase the *manojos* if they be counted. There is, among some card players, the vague remnant of a belief that if a hand be not picked up until the deal is finished, the cards will grow to higher denominations.

the rice sufficient, whereas it would not have been sufficient without their action.[6] This, of course, is only a vaguer form, a toning down of the old belief, made necessary by a growing intelligence.

The *kolating* is always celebrated on the day on which the owner of the *alang* begins to cut his rice. In the early morning before either harvest or feast commences, the owner of the fields kills a chicken and examines its gall bladder for an omen as to whether or no the time is propitious for the harvest. A full, black bladder is a favorable sign in this case, as in others in which the gall bladder is examined for an omen, as, for example, in cases of sickness or departure on a journey. Unless the chicken is diseased, the gall bladder is always full early in the morning at which time the digestive organs have for some hours rested from their functions. If, by chance, the gall bladder is white, or empty, the harvest and feast are postponed for two or three days, when the omen is consulted again.

The harvest feast takes place at the granary. The doors of the latter are decorated with leaves of the *hagañga* tree and with *hagaga,* a kind of grass common in rice fields, similar to what is called "nut-grass" in some parts of the United States. These decorations are said to frustrate malicious human sorcerers and other enemies in their efforts to make the rice disappear rapidly and to decrease it in quantity.

The feast begins at about 10 o'clock in the morning. The *dotal,*[7] a kind of a mat made of long *runo* stems laid closely parallel and tied together with rattan, used on festive or funeral occasions, is brought from the granary, unrolled, and placed on the ground underneath the structure for the people to sit on. The mat fits the space under the granary. *Bubud* jars, *augang,* generally two, holding from fifteen to thirty liters each, are set in the center of the mat. These jars contain the fermented rice, the malt called *bubud,* and the *binabudan,* or rice wine, called *tapui* in Benguet, and *tafei* in Bontoc. Sometimes the rice wine is termed *binadayan,* but *binadayan* and *baya* are generally terms for intoxicants and apply to the *basi* and gin of the Christian Filipinos and the whisky of the Americans. Usually, there are about four and one-half liters of the beverage in an average-sized *bubud* jar; the rest is malt. Wooden bowls are provided into which the *binabudan* is strained from the *bubud* jars by means of three or four round stalks which hold

[6] There is a feast called *humañgali page* given every year by such persons as find the rice in their granaries being consumed more rapidly than they think it should be. Last year, 1909, a partially Christianized Ifugao, one of the municipal officials, refused to give the harvest feast. When, after about three months, he found that his supply of rice was being used up too fast, he gave this feast hoping to mend matters.

[7] *Dotal* is the ordinary Ifugao word for floor. It is applied to the mat here referred to because the mat is used at the feast to make a floor.

the malt back in the jar. The rice wine is dipped up from these wooden bowls by means of coconut shells, *taug,* the rims of which have been notched to fit the mouth. Wooden troughs, *tiñgap,* are filled with betel nuts and betel leaves.[8] In one trough are some twelve to twenty stones called *buga.*[9] Whenever an animal is killed at the granary some of its blood is smeared on each of these stones, the person smearing it saying: "Thou, blood stone, do not get lost."[10] Three or four *palipal,* or bamboo clappers, are placed in the trough with the *buga.* The *palipal* is essentially a partially split stick of bamboo about fifty centimeters long, the halves of which clap sharply together when it is shaken. A large flattish basket of cooked rice, *hinamár,* is provided for the *linauwa.* According to the Ifugao, everything living or dead has an invisible, immaterial shadow, and it is this shadow that the *linauwa* use. After repeated investigations I have been unable to find any term for this shadow. When hard pressed for a name two or three men have called it the *linauwa;* but a *lanauwa,* strictly speaking, is the soul of a man, an animal, or a plant. At any rate, it is a convenient provision of the Ifugao religion that the spirits use the invisible, immaterial, part of the rice wine, betel nuts, blanket, bolo, or other offering, leaving the material part for the consumption or use of the living. After all these things, *bubud,* betel nuts, betel leaves, cooked rice, *palipal,* and blood stones, have been placed in the center of the mat, the people take their places, squatting in a ring about them.

Let us look at the principal actors in the ceremony about to begin. There are twenty men and three women present, this being about the usual ratio of the sexes represented at these feasts, and any number of small boys and girls. The larger children are busy in the rice fields. Occasionally, however, one of the large boys who is carrying rice to the granary remains for a few minutes to watch the ceremonies, and to rest after climbing the steep hillside. A typical feast will be described.

[8] The betel nuts are kept in the troughs from year to year. In some of the prayers of this feast the rice is called on to become hard and dry in imitation of the betel nuts. It is told to "follow" the betel nuts, which stay in the granary from year to year; not to be eaten up; not to disappear, but to have a portion left at the next harvest.

[9] The following is the story of the *buga:* Alingdayu, the place spirit of Nagadañgan, used to eat gold. In his stomach the gold turned to stone. He gave this stone to Balitok, the Ifugao Noah, who, with his sister Bugan, survived a flood that drowned all other people. Alingdayu told Balitok that so long as he kept the stone he would have good crops. Balitok put other stones with this original stone and these others acquired its properties. He gave them to his children and they have added to the number according to the demands of the increased population.

[10] *He'a, buga, adika mondekela.*

The granary belongs to Kodamon, one of the richest men in Kiangan and a typical representative of the upper class Ifugao, the *kadañgyan*.[11] He is tall, well proportioned, and of middle age. He admires the white man and respects him; but his tribal pride, together with a most admirable sense of the fit and harmonious, holds him, it has often seemed to me, true to the religion and life of his fathers. He apes neither the white man nor the Christian Filipino. It is as if he preferred to remain (and this in contrast to certain of his fellow *kadañgyan*) a good Ifugao rather than become a "half-and-half." He knows, as an Ifugao *kadañgyan* ought to know, all his ancestors, male and female, for six or seven generations, and can trace his genealogy in a direct male line to Balitok, the Ifugao Noah. His two sisters and his wife are nearly of his age. They are vigorous appearing women who have worked hard in their time, but now have daughters to take their places in the rice fields. Gimbuñgan, Kodamon's father, is a very old man, almost blind. No one in the region is better versed in the Ifugao folklore and religion than Gimbuñgan. His faculties, however, are waning. Whenever he starts an invocation, or phase of ceremony, he goes through it like an automaton, and immediately repeats it again and again until Kodamon starts him off on something else, a task performed respectfully and with evident filial love. Kodamon has carried Gimbuñgan[12] a distance of over 3 kilometers from Loñga to Pinduñgan, where the feast is to be held; for the old man is too feeble to walk so far. Eight or nine middle-aged or elderly cousins, and a pig, complete the list of those who take a leading part in the ceremony.

The younger men[13] play the parts of acolytes and exhorters; they strain the rice wine, hold the cup for the old men who are praying, hand them *palipal* or whatever else may be needed. Not knowing the proper

[11] Padre Juan Villaverde applies the term *nobility* to this class. *This Journal, Sec. A* (1909), 4, 241.

[12] As this is being written, Gimbuñgan is afflicted with a derangement of the faculties of speech. He has directed Kodamon to find a dog to be killed at a feast; he says that a dog is the proper animal to cure this particular affliction. It may be that he has had a dream to that effect, or it may be that this belief is due to the fact that the dog has more powerful and versatile vocal organs than any other animal known to the Ifugao. Judge the dilemma in which Kodamon finds himself. He would like to obey, it his duty to obey his old father; but for an Ifugao *kadañgyan* to eat dog! It would never be forgotten, and years hence, in the drunken babbling around the *bubud* jar, Kodamon would hear of it!

[13] By younger men I mean the younger middle-aged men, for no youths take part in feasts.

forms and the names of the deities, they exhort and call out phrases of encouragement as the others pray or chant.

Oh! that's it! Oh grant it! Come, ye deities! Take the pig, you deities! Drink the rice wine! Make the rice heavy! Speed the harvesters![14]

These and other phrases the young men call out in a high, falsetto voice as the ceremonies and prayers proceed. Those who perform this office are called *montobal,* exhorters. I have been invited on several occasions to join the young men in this, and on one occasion I accepted; but for an American to summon the *bagol* was, I thought, an unbecoming and, in fact, a sacrilegious levity. However, the people did not regard it as such. In fact, while the people are most sincere in their belief, their religion has not yet reached that stage where ceremonies are conducted with outward tokens of great awe, respect, and solemnity. It is the pig, the betel nuts, the *binadayan,* and cooked rice that the *bagol* want, not praise and long, grave countenances, for the deities are very material in their desires.

The pig, with his feet lashed together, and a small pole passed between them to hinder his struggles, is placed in front of the granary door near the mat. (See Pl. II, fig. 2.)

The drum is the only musical instrument employed at the harvest feast. Sometimes one is used, sometimes two. The drum is played in double time. It accompanies nearly all the ceremonies.

All ceremonial circuits in the harvest feast are counterclockwise, beginning at the east, in front of the door of the granary. The people say that the *bagol* must have told Balitok and Bugan (the man and woman who survived the great flood) to proceed so, and they believe that if a man were to go around in the other direction he would surely fall off a steep cliff in a journey, or else lose his way.

About the middle of the forenoon the people commence to drink rice wine and invoke the *linauwa* of the *monlapu.* So begins the first part of the ceremony.

*The monlapu leaders in rice culture.*—Dulduli, the mother of Santiago, a rich man of Baai, is the *monlapu* of Kiangan disrict. That is to say she is the one who decides when each phase of rice culture shall begin, and takes the lead in each. She first begins spading, planting the seed, transplanting, and harvesting. Until she has begun these things, no one else may begin under penalty of misfortune, of bad crops, very likely of death. Dulduli became the *monlapu* in response to a dream that came soon after the death of the former *monlapu.* She is currently believed to have eight years to reign in this capacity, when she will die. When

[14] *Oh hia! Eh damú! Umalikayun bagol! Ialim di babui dakayun bagol! Ambayan di binadayan! Manan̄gali page! Ikwadim di monagamid!*

she dies, she may inhabit, in the spirit, a tree or a boulder, or she may become a new spring, as did the last *monlapu* in Ligaue. Sometimes the *monlapu* is a man. In case of bad crops the *monlapu* finds himself universally blamed for them. He is considered to have been lax in his religious duties.

As priestess of agriculture Dulduli makes feasts to ask in behalf of the village for rain if it be needed or for relief from a rice pest that may visit it. Just as in life she takes the lead in harvesting, spading, planting, and so on, so after death, she (or he) is the first of all the many spirits to be called to the harvest feast. All the *monlapu* who have ever ruled Kiangan agriculture, together with the *monlapu* of neighboring districts, are called to the feast.

*Invocation of ancestors. Monamud.*—The invocation and invitation of the souls of the ancestors is, so far as my knowledge goes, the first part of every feast of whatever kind, with the exception of the harvest feast in which the *monlapu* precede. The ancestors are invited to be present and to partake of the feast and drink the rice wine. (See Plate II.) An old man should be able to name his ancestors, both male and female, for at least six generations. Women do not usually know so many, but they call on those whom they do know. Each man invokes his own particular set of ancestors, and if none of his wife's relatives be present, her brothers or her father, he calls upon her ancestors too. In fact, he looks upon his wife's ancestors as his own in a way; and it is his duty to have learned them from her father. Complimentary remarks are addressed to the ancestors, as, for example, this one that I once heard: "Brave ancestor, Ananayo, you who speared the child-slave to death."[15] Spirits of ancestors can not directly affect the harvest nor the growth of rice, but they have the greatest influence with the spirits that do have such power, and with the spirits that bring fortune and misfortune, children, sickness, and death. They must never be slighted nor offended. Their feelings are quite delicate, and if a man neglects his ancestors, they will remove their watchful guardianship from him and misfortune of some sort will result. The prayer to the ancestors is extemporaneous, each man going about it in his own way. The word *sai,* long drawn out, is used in the following invocation:

> Thou, ancestor Ginnid, come, drink the intoxicant. There are betel nuts and betel leaves here. Thou, ancestress Bugan, daughter of Oltagon, etc.[16]

[15] *Mahúi Apo Ananayo, te timbuk di himbut ud nate.* Is this a reference to the sacrifice of a slave at some early time?

[16] *Sa-ai-ai-ai umali Apo Ginnid; umalika, uminum di baya. Tehtu momma ut hapid. Sa-ai-ai-ai ka Apo Bugan, nak Oltagon,* etc. In invoking the deities the word *sa-ai-ai-ai* is sung in a peculiar long drawn chant. It does not appear to have any meaning.

Rice wine is consumed at an alarming rate during this ceremony.

*Ceremonial killing of chickens.*—The invocation to the ancestors finished, some chickens are usually killed. The ceremonial killing of chickens is performed by cutting their throats with a sliver of bamboo. The blood is caught in a vessel and a prayer repeated as the chicken is dying. The chicken is then held over the fire until its feathers are burned off, when it is cut up with a knife or by a sawing motion of the bamboo sliver and put into a pot to boil. The intestines are stripped of their contents by being drawn between the thumb and finger. They are then put on a spit, and broiled before the fire. They are the portion of the cook. Of some twelve harvest feasts which I attended, the bamboo sliver was used at two. At others the knife was used. After the chicken has been killed, the blades of two *runo* stalks are tied in a peculiar manner, and the feet of the chicken stuck into these. Pieces of betel nuts wrapped in betel leaves and stuck on little sticks are tied in the blades. The *runo* stalks, so adorned and called *paghing,* are placed one on each side of the gate of the fence surrounding the granaries, or in the fence in front of the granary door. They are given to the *pili,* the spirit that guards the granary against thieves.

The invocation of the ancestors proceeds in a rather leisurely manner, and it is generally noon or even later when it is finished. The chickens that have been killed and cooked are not eaten, but are put in a wide, flat basket as an offering to the spirits that come to the feast. In fact the party has not eaten anything since the night of the previous day and continues to fast until the ceremonies are finished.

*The Ifugao conception of the universe.*—In order to make what follows intelligible, it is necessary to explain the universe according to the Ifugao's idea. The Ifugao conceives of three worlds: the Sky World, the Earth World, and the Under World. Each is populated by a variety of spirits, which live in groups of houses, in trees, gullies, springs, waterfalls, currents, stones, and houses made of skulls. There they abide much as mortals do. They have an insatiable appetite for pig meat, betel nuts, and wines; some of them at least need bolos, blankets, beads, and other things that man uses. In addition to the three worlds mentioned before, there are two regions, places where the three worlds meet: The East, *Lagod,* and the West, *Daya.* In the East live some very vicious place-spirits. The spirits in the East are much more numerous than those in the West. The Kiangan Ifugaos say that they themselves came from the East, which probably accounts for the fact that the East is more thickly populated with spirits. There is no northern nor southern region thus populated.[17] In fact, there are no words

[17] Villaverde is in error when he states that *Kadungayan,* the place where souls of those who die a natural death live, is to the north. *This Journal, Sec. A* (1909), 4, 248. *Kadungayan* is in the East.

in the language for north and south. If a Kiangan man wishes to say north, he names some remote place toward the north, as *ud Banawul,* toward Banaue, a village in a northerly direction from Kiangan.

*Invocation of the makalun. Monmakalun.*—The *makalun,*[18] the spirits that make men forget, that remind or suggest to them, are next invoked. The *makalun* may work a man great injury by causing him to forget the debts that are owed him, to lose spear or bolo, and so on. "The *makalun* are like police, also," say the Ifugaos, "they bring other spirits to the feast." This simile is perfectly clear when it is understood that a very small part of the work of an Ifugao policeman consists in preserving the peace, and that by far the greater part of his work consists in calling *cabecillas* [19] and *kadañgyan* for consultation; in carrying instructions to foremen on the trails; carrying the mails and the like. The *makalun* are messengers of the other spirits and of those men who know how to call on them in the right way. As it was explained to me, the *makalun,* when sent to call spirits to a feast, notify the chief spirit in each of the various villages of spirits. This chief spirit notifies the others that such and such an Ifugao is making a harvest feast, and that such and such spirits may go to it. An old man told me that the *makalun* tells the chief or *cabecilla* of the spirits something like this:

> The men are harvesting. Let us go to the granary of Kadamon and Gagaya. We will drink rice wine. They will give us their pigs, chickens, and rice. We will chew betel nuts.[20]

Some of the *makalun* most frequently invoked are: Ud Lagod (in the East) Tayaban,[21] nak Balud;[22] Tayaban, nak Tagudan; Tayaban, nak Manguli. Ud Kabunian (in the Sky World) Tayaban, nak Dalogdogan; Tayaban, nak Balitian; Tayaban, nak Amkidul; Bugan, nak Numbian; Bugan, nak Balitian; Bugan, nak Abugai. Ud Dalom (in the Under World) Tayaban, nak Ginita; Tayaban, nak Bahinag; Tayaban, nak Litnak. The number of *makalun* and the list of spirits that may be called upon to serve as *makalun,* varies considerably at different feasts. This is the most variable, and in fact the only greatly variable, feature of the harvest feast as performed in Kiangan villages.

[18] *Makalun: ma,* able; *kal,* word, speech; *makalun,* one who is able to tell or to summon.

[19] Spanish word used in the Philippines in the sense of chief.

| | | | | | |
|---|---|---|---|---|---|
| [20] *Mon-ani* | *di Ipuwao.* | *Ume-tako hi kalumaga* | *di Kondamon ya* | | |
| Are agents of harvesting | the human beings. | Will-go-we the granary | of Kodamon and | | |
| *Gagaya;* | *Mañginum-tako baya.* | *Idat-tako babui,* | *ya manok* | *ya páge-da.* | |
| Gagaya; | Will-be-agents-of-drinking-wine. | Will give us the pig, | the chickens, | the rice-their. | |
| *Monmomma-tako.* | | | | | |
| Will-be-agents-of-chewing-betel-we. | | | | | |

[21] *Tayaban.* See under heading "The Tayabans" of this article.

[22] *Nak,* son of.

The people call the *makalun* thus, drinking quantities of rice wine at the same time:

Come thou, Tayaban, the Messenger Deity, son of * * *. Notify the souls of our ancestors to come. Notify the Deities of the Sky World, of the Under World, of the East, of the West, to come. Notify our relatives and our companions. Summon Banuyuk of Panuyu. In order to speed the harvesters of the rice; in order to multiply the bundles of the rice. There are rice wine and betel nuts and betel leaves here.[23]

These and similar phrases are repeated over and over, the fervor of the feasters growing the while.

Suddenly some of the feasters, perhaps three or four, perhaps a dozen, are seized upon and possessed by an equal number of *makalun*. Through these human agencies, the *makalun* chant:

We will call your relatives and companions and the spirits of the Under World, of the Sky World, of the East, and of the West, because you are making a harvest feast.[24]

So ends the second ceremony of the feast, the *makalun* leaving the bodies of those whom they have possessed and starting off on their errand immediately.

*The earth gods and the sky gods.*—These deites, of all those whom the Ifugao calls to the harvest feast, are the only ones of sufficient dignity to be termed gods. Their benevolence generally exceeds their malice, which is not true of the other deities; and they control some of the forces of nature.[25] Bahiwag and his brothers, Dunuan and Tinukud live in the Under World. They are thought to have a great deal to do with the growth of plants, especially with germination. Dalogdogan, Balitian, and Bayuhibis live in the Sky World and control the weather. Balitian makes rain and Bayuhibis makes mist. They are brothers of

[23] *Sa-a-a-i Umalika Tayaban an Makalun, nak * * *. Kalunum di linauwa di amud ta umalida. Kalunum di bagol ud Kabunian, ud Dalom, ud Lagod, ud Daya, ta umalida. Kalunum di mundomang*[a] *ya nunhalug. Pananduan hi Banuyuk ud Panuyu. Ta ikuadin di monagamid di page; ta gumalutigid di udung*[b] *di page. Tehtu baya ya momma ya hapid.*

[24]

| | | | | |
|---|---|---|---|---|
| *Sa-a-a-i* | *Komalum-kami* | *mundomang,*[c] | *manhalung* | *Idalom*[d] |
| Say! | Will-be-agents-of-calling-we | relatives | companions | Residents-of-the Under-World |

| | | | |
|---|---|---|---|
| *Ikabunian* | *Ilagod* | *Ipaádan*[e] | *te mon-kolating-kayo.* |
| Residents-of-the Sky-World | Residents-of-the East. | Residents of the West | because agents-of-performing-harvest-feast-you. |

[a] *Mundomang:* relatives, including relatives by blood and relatives by marriage.

[b] *Udung,* butt of the *manojo* of rice; poetically, the whole *manojo.*

[c] *Mundomang:* See note *a.*

[d] *I,* as a prefix in the Kiangan dialect, denotes residents of; as, for example, *Ikiangan,* residents of Kiangan; *Idalom,* residents of Dalom, the Under World.

[e] *Paádan,* a place to the west; figurative term for West.

[25] Another quality of their godhood is that so far as any Ifugao knows, they have always existed. They were not born of parents. There is no story of their creation so far as I have been able to ascertain.

Amkidúl and Bagilat, who respectively make thunder and lightning. These gods are the same throughout Ifugao-land, notwithstanding the fact that there are ten or twelve different dialects in the subprovince. They are invoked by the entire body of feasters, in the usual high, falsetto voice, in these or similar phrases:

Oh come! Bahiwag of the Under World. Drink the rice wine. Take the pig. Speed the harvesters of rice. Oh! that's it! Bagol! Make the rice grains as numerous as the sands. Miraculously increase the rice! Oh! Grant it! Come thou! Make the rice heads hang over (with weight). Oh! that's it![26]

The gods are called separately and in groups. Suddenly one of the gods (Bahiwag[27] always comes first) comes and possesses a feaster. The latter springs up, seemingly without premeditation, seizes a dish of rice wine, or, it may be, one of the big *bubud* jars, swings it with a circular motion under the granary, at the same time hopping with the characteristic Ifugao dance steps. The cries and calls of the feasters and their white-heat fervor leave no doubt that here is a religion the letter of which has not yet superseded its spirit. The one possessed drinks and gives the others to drink, chanting the while:

I come up from below, I, Bahiwag. I behold with favor that you are making a rice feast. I dance, and I drink the rice wine. Drink, you participants; because I am giving you to drink. I taste the chicken, the pig, and the rice, as I have been accustomed to do in times past. Thus I drink in dwelling and granary. I desire it so year after year.[28]

The one possessed passes to the front of the granary where he executes a little dance. Another feaster, of either sex, who has been possessed by Tinukud, one of the other two spirits from the Under World, quickly follows him, and together they dance and chant:

We are the miraculous increase of the rice. We are the slowness of the rice to be used up. We are harvest-knives and ties.[29]

[26] *Sai! Umali Bahiwag ud Dalom. Añgbayam di binadayan. Ialim di babui, Ikwadim di monagamid. Oh-h-h hia! an Bagol! Pumantal di Biñgga. Humañgali page. Eh-h-h Damú! Umalika. Lumatok di bintok. Oh-h-h hia!*

[27] Bahiwag is chief of the gods of the Lower World. Dalogdogan is chief in the Sky World. [There seems to be some doubt as to whether these two gods are considered as leaders in any sense. EDITOR.]

[28]

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|---|---|---|---|---|
| *Sa-ai-ai-ai!* | *Limadañgak hi* | *Bahiwag ud Daul.* | *Belibeliokak* | *Kolatingyo* |
| | Came up I | Bahiwag of Below. | Object-of-sight-mine | Making-harvest-feast-your |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Kadayaowak ya angbayak di binadayan.* | *Tinulpangkayo* | *baliknadan* | *te impiñgak* |
| Gift-mine and drink-I the intoxicant. | Drink-ye | participants | because |

| | | | | | |
|---|---|---|---|---|---|
| *matoldadawak hi* | *manok ya* | *babui ya* | *page-yo* | *ta impainghak di* | *kakohayan.* |
| give-taste-I the | chickens and | pigs and | rice-your | has been habit-mine in the | time-past. |

| | | | | |
|---|---|---|---|---|
| *Mobanum* | *tinulpang* | *i haláon ya* | *kalumaga.* | *Pudhok at hitu katáwotáwon.* |
| Thus (?) | drink (in) | the dwelling and (in the) | granary | like-I so yearly. |

[29] *Tanglé-kami. Gikud-kami. Gipan-kami, binuyu.*

The second feaster takes the dish of wine from the first and offers it to him. He bends and drinks a long draught and then returns to his place on the mat, spewing out the last sup of rice wine on the ground. (See Pl. III, fig. 1.) The second performer now executes some fancy steps and chants. He is joined by a third who, after the usual little dance, relieves his companion of the dish of wine and holds it out at the level of his waist for the ceremonial drinking. And so it goes until the drinking has been repeated six times, that is, once for each god.[30]

There follows a recess in which the participants relax from the high-wrought and heated fervor in which they find themselves at the end of this ceremony. They sing work songs and songs of amusement. At about this stage of the feast, too, the drunkenness has usually proceeded far enough for the inevitable boasting about wealth and fields to begin. An Ifugao's prestige among his fellows is fixed by the number of rice fields, of gold neck-ornaments, and agate beads, *pañgo,* he has, by the number of feasts he gives, and the number and kind of animals he has killed at these feasts. These facts determine the trend that the drunken babbling usually takes. Rare, indeed, are the recesses between ceremonies, from this point on, when some particularly poor relative does not amuse the company with a recital of his enormous wealth and of the feasts he is going to give.

*The anointing. Monlana.*—These gods, a lower order of beings than the preceding, and more to be feared, as they belong to an order more malicious, now demand attention. Asked if these spirits are bad, the people say: "Yes, bad; but also good, if treated well." The people say that these spirits steal the life of the rice if the customary offerings and respects are not paid them at harvest time and that they may even diminish the rice in the granary; but if coaxed and cajoled in the proper form, they "bring the life of the rice," and even increase it during harvest and after it has been stored in the granary.[31] They are invoked

[30] In the feast of Kodamon and Gagaya, the actors were four men and two women.

[31] The old men are very argumentative in their invocations to these and other malicious spirits. They try to convince them of the error of maliciousness directed toward those who treat them well. The following is one argument: "If you do evil to those who give you feasts, of what use is it to offer these feasts? Soon no one will kill pigs for you, or give you betel nuts; because you prey upon your friends as well as upon those who neglect you." The following spirits are usually called on, although the list is slightly varied by additions, there being a legion of less important spirits of the same class: Lukbukan of Binuyuk;[a] Alingdayu of Nagadañgan,[a] Mongahid of Nantogan;[a] Binongbong of Lantogan;[a] Humidhid of Ilayap;[a] Dinkom of Imaloi;[a] Balud, nak Dinkom of Nuayan;[a] Tugadan of Ibaya;[a] Intikap of Kahilauan;[a] Inudoman of * * *.

[a] Names of places a few miles east or northeast of Kiangan.

by phrases similar to those used in calling the gods in the foregoing ceremony. A bowl containing chicken grease is passed about by a feaster, possessed by Tayaban, son of Mongáhid, who dances and chants as he goes. As he passes each head, he dips his finger in the grease and anoints the head of each person who is taking part. The feasters shout:

We put oil on our heads, in order to put oil on the heads of the harvesters of the rice, in order to make the rice increase.[32]

The people can not explain this custom of anointing, nor the chant that accompanies it. They only say, "That is the right way to perform a harvest feast." The following explanation is favored by certain evidence, and presented to the reader for what it may be worth. It is to be noted that all these spirits are place-spirits, and that their residence, Binuyuk, Nagadañgan, Nantogan, etc., are all places in the East, which, according to the Kiangan Ifugaos, is the cradle of their tribe. Now when an Ifugao makes a new rice-field, he always performs a ceremonial feast called *lañgalang,* killing some chickens to appease the spirit who resides in the locality. Otherwise, the place-spirit would make all sick who disputed dominion with him and disturbed his peace by working his land. He would cause the field to be washed away, the rats to eat the young rice-plants; in short, he would make the field an utter failure. It may be that in times past this ceremony was performed annually, whenever the land was worked or whenever the crop was harvested; that the workers marked themselves with fat of the sacrificed chickens in order that the place-spirit might know those who had made the proper sacrifice; that the custom still survives in the harvest feast; and that the feasters, as they say, anoint themselves "in order to put oil on the heads of the harvesters." The custom, so explained, has points in common with the Hebrew Passover. Like the angel of the Lord, these terrible spirits "pass over" those who present evidence of having complied with the requirements.[33] These faithful ones the spirits do not make sick nor punish by stealing the life of the rice. If, as the Kiangan Ifugao says, these spirits come from the East, it is to be noted that they still pay homage to the place-spirits of their former habitat; and, hallowed by time, they now rank little lower than gods.

| | | | | | |
|---|---|---|---|---|---|
| [32] *Monbelabela-kami* | *ta* | *monbelabela* | *di* | *monagamid* | *di page,* |
| We-put-oil-on-our-heads | in-order-to | put-oil-on-the-heads | of-the | harvesters | of the rice |

*ta gumikud*
in-order-to-make-the-rice-increase.

[33] The meaning of white chicken feathers worn in the hair, now purely ornamental, at first may have been a demonstration to the spirits that the wearer had made the proper sacrifice.

After the foregoing ceremony, and in preparation for the succeeding one, an old man anoints the bamboo shakers, saying:

I anoint the *palipal* in order to do the same to the rice; to make soft and tough the rice (straw) in the fields;[34] to speed the harvesters; to multiply the bundles of rice in the fields in order that the harvest may be great; in order that the rice heads may hang down;[35] so that the harvest will be heavy; in order that the empty space in the granary may be filled with plenty.[36]

*The tayában. Monligid.* (Procession with shakers.)—The *tayaban* are predatory spirits almost without redeeming qualities. They are able, it is said, to increase the rice, "because they are divinities;" but this is through analogy with the place-spirits, and the gods of the Sky and Under Worlds. As a matter of fact, not much is expected of them except neutrality. If this nuetrality is not secured, they steal "the life of the rice;" they decrease it after it is stored in the granary; they fly in the night, hunting *linauwa,* souls that have wandered off in dreams;[37] they kill the fœtuses of pregnant women. Tayaban hi Apolili, is the genius of landslides. The *tayaban* that are called to the rice feast are Tayaban, nak Lukbuban; Oltagon, his sister; Tayaban, nak Alingdayu; Tayaban, nak Binongbong; Indagan, his sister; Tayaban, nak Mongahid; Tayaban Kawángwángan;[38] Tayaban, nak Humidhid; Tayaban, nak Tugadan; Tayaban, nak Mañguli; Tayaban, hi Duyug;[39] Tayaban, nak Dinkom; Tayaban, nak Balud; Tayaban Inudoman.

The *tayaban* are summoned orally in much the same manner as the spirits in the two foregoing ceremonies. They are asked to increase the rice, multiply the grains and bundles and make them heavy, "In the hope," said an old man, "that they will hear what the other spirits do, and do likewise through shame." When the *tayaban* come, they take possession of the feasters, by twos, usually a man and a woman, the man first. The *tayaban* then cause them to take *palipal,*[40] bamboo clappers,

[34] So that it will not fall down, and the grain be scattered and lost.

[35] From weight.

[36] *Ilana-ak hi palipal ta ukulan di page; humayumut ya pomatlag indaluñgene; ta ikwadin di monagamid; ta gumalutigid udung nan indaluñgene hi bananu, ta dakol ni ánian; lumatuk di bintok ta dakol di ánian, ta inhigup natdañgan di hinumpkal.*

[37] They carry away and imprison the *linauwa,* thus causing the person whose *linauwa* was stolen to languish and die. The body without a *linauwa* is like a palm tree without a bud.

[38] *Kawangwangan;* of the streams. *Wangwang,* a stream; *ka,* a prefix of abstraction and denoting extension.

[39] Tayaban hi Duyug. *Tayaban* of the *baliti* tree.

[40] Mr. H. Otley Beyer, of the division of ethnology, Bureau of Science, tells me that in Banaue, if a feaster breaks a *palipal,* he must make an expensive feast to ward off misfortune, and is tabooed from taking part in any other harvest feast until the next year. This is probably the case in Kiangan also.

and with the characteristic Ifugao ceremonial steps, proceed around the granary, or if there be, as there usually is, more than one granary in the inclosure, to proceed around all of them. (See Pl. III, fig. 2.) At each of the four corners, the *palipal* is outstretched toward the sky and sharply clapped. (See Pl. IV, fig. 1.) While this procession is passing the feasters are fervently calling on the *tayaban* in high falsetto voices, and telling them what is desired. They say:

"Do not travel through our houses and our granaries and our villages. Fly over them. Do not frequent our fields nor our forests nor our roads. Fly around them. Harass our enemies. Do not diminish our rice. Increase it." And so on.

As the actors complete the circuit, a feaster with a cup of wine in his hand executes a little dance before the pig and pours on it a little rice wine, saying at the same time, "Get the pig, you spirits."[41] After the wine has been poured on, he says: "Oh, that's it! A libation has been made the spirits!"[42] This circuit is performed four or six times. Usually the first actor is relieved by others. At the completion of each circuit, wine is poured on the pig.

*Coming of Buluhan, Monbuluhan.*—After a recess Buluhan, nak Lukbuban of Binuyuk,[43] is called. Buluhan is conceived of as an enormous creeping being, like a snake. He is called on in the usual phrases to come and partake of the feast and to increase the rice. Finally, he comes and possesses a feaster. The one so possessed takes a piece of betel nut in his mouth and a betel leaf. With these between his teeth, the leaf projecting like a snake's forked tongue, he squirms and wriggles over the rice that is stacked under the eaves of one side of the granary (for no rice is put into the granary until after the feast) in imitation of the creeping of a snake. He chants:

I have come from the East, I, Buluhan, son of Lukbuban, who live in Binuyuk. I give (what you ask). I increase the rice. I drink the rice wine, as I have been accustomed to in time past.[44]

The feaster wriggles to a bowl of *bubud,* rears his head and gazes at the pig. At the same time, another feaster pours rice wine on the betel nut from his mouth and drinks from the dish.

[41] *Ialim di baboi dakayun bagol.*

[42] *O hia! Nagilig an bagol.*

[43] Binuyuk, a place in the East.

[44] *Himungduak*[a] *hi Buluhan, nak Lukbuban Ibinuyuk,*[b] *kadayaowak ta humañgale page. Angbayak di binadayan ta impayinhuk di kakohayan.*

[a] Himungdu, come from the East. Humabang, come from the West. Lumadang, come from the underworld. Nunudnud, come down from the Sky World. These words are used only in religious ceremonies.

[b] Ibinuyuk, residents of Binuyuk.

*Bugan.*—Bugan, nak Pundakugan, is the owner of all the locusts. "Locusts," say the Ifugaos, "are her chickens." A woman takes betel nuts and betel leaves, with some malt,[45] *bubud,* in a wooden bowl, and dances in front of the granary, one hand upraised. She waves her hand, saying: "Bugan of Binuyuk, daughter of Pundakugan, betel nuts, betel leaves."[46]

The feasters invite Bugan with loud cries, and the old men pray to her and argue with her against the folly of injuring her friends. The argument may run:

> Turn your grasshoppers on the fields of our enemies, or of those who do not give you the things you want, and do not injure us, your friends, who give you rice wine, betel nuts, and pig.

As the woman dances, a libation is poured on the pig. Bugan nak Humanun tells her husband to go at night to steal the life of the rice of those toward whom she is spiteful. She is invited to the feast by the same ceremony as that observed in inviting Bugan Pundakugan.

*The wind deities. The púok.*[47]—The *púok* are possessed of considerable power over the forces of nature; they control the strong winds, the winds that come with typhoons; they can increase the rice during harvest time; they can steal its life away and cause it to languish and die before maturity. It is a very noteworthy fact that in the religion of the Ifugao there is no clearly defined division of labor between the spirits or classes of spirits. Thus, the place spirits, the *bugan,* the *púok,* and even the *tayaban,* are besought to increase the harvest, although the *púok* are primarily controllers of the strong winds and the *tayaban* are predatory spirits. The wind deities usually invoked are four: Dinipáan of Paádan;[48] Púok of Halamban;[49] Púok of Ambatu;[50] Púok of the East.

The distinction between the *púok* of Halamban and the *púok* of Ambatu is that strong winds caused by the former are not accompanied by rain, while strong winds caused by the latter are so accompanied.

The feasters invite the *púok* in the usual terms and call upon them to increase the rice. The special phrases of the invocation of these spirits are:

[45] The Ifugao not only drink rice wine, but eat its malt.

[46] Bugan ud Binuyuk, nak Pundakugan bibihalag dañgaidahan.

[47] *Púok:* a strong wind.

[48] Paádan, a place about three miles west of Kiangan.

[49] Halamban, a place toward the south.

[50] Ambatu, a place toward the south.

. Rice wind, wave the rice in the fields, but return its soul (life?). Make healthy its soul. Do not fell the houses and granaries. Do not summon the rains because we are harvesting. Here, you have rice wine and pig, etc.[51]

A feaster is possessed. He takes a basket containing betel nuts and betel leaves, malt, and a coconut shell containing rice wine, and with a *palipal* in hand proceeds swiftly [52] about the granary, with the Ifugao ceremonial steps, rattling the bamboo clapper vigorously [53] at the four corners of the granaries and chanting as he goes:

We are the slowness of rice to be used up. We are the miraculous increase of the rice. We are the life of the rice. We are the harvest knives.

This procession is repeated four times, once for each *púok*. At the termination of each circuit, rice wine is poured on the pig, the person pouring it crying: "A libation has been made unto all you *púok*."[54] Usually the circuit is performed by a different actor each time. (See Pl. IV, fig. 2.)

*The bakayauan. Monbakayauan.*—The *bakayauan* are powerful deities that go armed with spears. They are hunting spirits. Some of them have dogs. They are offered sacrifices by hunters, and go to the chase with them. Most of them live in the Sky World, some in the Under World, and others have special places in the East.[55]

The feasters begin calling *bakayauan* to the feast. Suddenly one of their number springs up, seizes a spear [56] from those stuck in the ground

[51] *Pumpúok hi page, inumyum di page, mu ibangad di linauwa-na. Adikayo tiwan di halaon ya kalumaga. Adikayo ayagan di udan te monaki-kami. Tehtu binabudan ya babui, etc.*

[52] Note the connection in the Ifugao's mind between the passage of the wind over the rice and its health and growth.

[53] Note that the manner in which this procession is made is symbolic of a strong wind.

[54] *Nagilig dakayun púok, amin.*

[55] These deities are: Bakayauan, nak Panuya, Kabunian; Bakayauan, nak Balitian, Kabunian; Bakayauan hi Tayaban, Kabunian; Bakayauan, nak Holdayan, Kabunian; Bakayauan, nak Mañgamalig, Kabunian; Bakayauan, nak Balitok, Itapugan; Bakayauan, nak Lauan, Dukligan; Bakayauan, nak Dinlugan ud Dulom; Bakayauan, nak Domagaan, Kabunian; Bakayauan, nak Lakmayan, Kabunian; Bakayauan, nak Buluhan, Kabunian; Bakayauan, nak Amgumagub, Kabunian.

[56] The spear must be a bright handsome one, of the class called *bolobog*, or of that termed *gayang*. This latter is called by Jenks the "anito spear." At one feast I witnessed in a small group of houses no handsome spear of either of these two classes could be found. The procession about the granary was omitted.

near by, dances before the door and then proceeds around the granary. Holding the weapon in both hands, he brandishes it with an upward and downward wave-like motion as he goes. His black eyes shine; he has the appearance and glance of a madman. He chants:

Harass (or, bewitch; torture) the enemies, and the rice disease, and the sorcerers (those who do evil through their bad ceremonies) and the pests.[57]

The feasters cry out in the same and similar phrases and with the ever present prayer that the spirits increase the rice. The procession is repeated two, four, six, or eight times. At the end of each procession the actor executes a little dance before the pig, and after two or three threatening gestures throws the spear across the pig, sticking it in the ground a meter or so beyond. The spear is thrown from a distance of three to five meters as near as possible to the pig without injuring him. At the same time rice wine is poured on the pig, accompanied by the usual phrases. (See Pl. V, fig. 2.)

*The Koliaban, or Coverer.*[58] *Monkoliaban.*—A blanket dance is the ceremony of this spirit. (See Pl. VI, fig. 1.) The dancer is believed to be possessed. The dance is very graceful, and resembles one I have seen performed by Bagnen and Besao Igorots in Lepanto. The people invite and beseech the *koliaban* in the usual terms and in addition make the following plea:

Cover up (smother) thou the lack of rice, the hungry time, the rice disease,[59] and the pest; but do not cover up the chickens, the pigs, and the rice. Cover up thou the sorcerers, the persons who do evil through bad feasts, and the persons who cause pests.[60]

*Ceremonial killing of the pig. Monwíwik.*—The pole is removed from between the legs of the pig, which is then turned with its head to the east, for pigs are usually ceremonially killed facing the east. One man holds the legs so that the animal can not struggle; the person who is acting as cook cuts through the skin just below the sternum and pushes into the chest of the helpless animal a *runo* stalk, *wíwik,* about a foot

[57] *Hañgo hañgonmo hai binuhul utyai hiba utyai mangidat utyai balandag.* This is probably only a fragment of what he chants. It is all I have obtained as yet.

[58] Cf. the *Sa-rukub rang buni* of the Malays. The World Coverer, Malay Magic. p. 94.

[59] The disease of the rice, not the sickness caused by the new rice as described by Jenks. The Bontok Igorot, *Ethnological Survey Publications.* Manila (1905) 1, 107.

[60] *Koliaban-mo hai bitel, hai duian, hai hiba ya hai balangdan; mu adim koliaban hai manok utyai babui utyai page. Koliabanmo hai mañgidut, hai manongdong, utyai mondayapat.*

long. This he thrusts into the animal's lungs, the while it squeals piteously. Generally it takes some time to kill the poor animal, as the stick is usually too blunt to puncture the walls of the heart or other large blood vessel, and the animal dies from hæmorrhage into the lungs. (See Pl. VI, fig. 2.) While the pig is being killed the old men pray most fervently.

*Burning the hair off the pig. Monlagim.*—The hole in the pig's breast is plugged with a piece of *runo* and the animal is held in the fire, or laid in the fire until the hair and epidermis are charred. The body is then scraped. Needless to say, the animal is much bloated by the heat. (See Pl. VII, fig. 1.)

The Lepanto Igorots go through the same procedure with the pigs and dogs that they kill.

*Dispatching the spirit of the pig. Monhu-aa.*—After the pig has been scraped, a wreath is made of the stick of *runo* with which it was killed, two or three heads of rice, and a spray of *hagaga* grass. (See Pl. VII, fig. 2.) The pig is placed in the center of the mat, and decorated with the wreath. The feasters gather about, and, grave and silent, sit down while an old priest charges the pig's soul as follows:

Thou art enwreathed, pig, because thou art a young pig that wast used at a harvest feast; (and) in order that ye all, rice, hagaga, death stick (wiwik, the stick used to kill the pig) and pig, may go in company. Rise ye all unto the Sky World. Arrive unto the quarters of Ampûal, Balitian, Humamu, Wigan, Bayuhibis, Dulayan, Humok, Dakwigan, Numbian, Baluog, Amgaliñgan, Bañganan, Intoldaon, Umbumabaka. Tell them, pig, that the men killed thee; that they sacrificed thee. Say thou, pig, "I was sacrificed at a harvest feast." Tell the *bagol* to increase the rice, to make the rice heavy, in order that the empty space in the granary may be filled with plenty. Do not remain speechless. Do not tarry, sleeping, pig.

Thou art enwreathed, pig, because thou art a young pig that wast used at a harvest feast; (and) in order that ye all, rice, hagaga, death stick and pig may go in company. Descend ye all unto the Lower World. Arrive unto the quarters of Bahiwag, Tinukud, Dunuan, Kaliog, Lutwag, Ginita, Humamu. Tell them, pig, that the men killed thee, that they sacrificed thee. Say thou, pig: "I was sacrificed at a harvest feast." Tell the bagol to make the rice heavy in order that the empty space in the granary may be filled with plenty. Do not remain speechless. Do not tarry, sleeping, pig.

Thou art enwreathed, pig, because thou art a young pig that wast used at a harvest feast; (and) in order that ye all, rice, hagaga, death stick, and pig, may go in company. Proceed ye unto the East. Arrive unto the quarters of Lukbuban, Binongbong, Alingdayu, Mongahid, Balud, Tugadan, Mañgali, Panikdapan, Pûok, Nabalud, Dinumpitan, Binudbud. Tell them, pig, that the men killed thee, etc.

Thou art enwreathed, pig, because thou art a young pig that wast used at a harvest feast; (and) in order that ye all, rice, hagaga, death stick, and pig, may go in company. Proceed ye unto Paâdan (the West). Arrive unto the

quarters of Kabigat, Dinipáan, Dumugung, Nalipang, Ambatugan. Tell them, pig, that the men killed thee, etc.[61]

*The cutting up of the pig.*—The small boys, who have listened patiently during this rather lengthy prayer, now have their reward. While the greater part of the animal is eaten at the granary by the feasters and

[61] Wagáhan daka babui te kinlum daka, te impañga daka page, ta monkakuyug-kayon page, hagaga, wiwik, ya babui. Tumalakdang-kayo kabunian. Dutnangyo hudok nan Ampúal, hi Balitian, hi Humamu, hi Wigan, hi Bayuhibis, hi Dulayan, hi Humok, hi Dakwigan, hi Numbian, hi Baluog, hi Amgaliñgan, hi Bañganan, hi Intoldaon, hi Umbuma-baka. Imbagadaka babui dimatayanda he'a; nañgi-padúanda babui ke he'a. Humapitka babui 'Impaduyu-ak hi kolating.' Komali din bagol ta gumikud di page, ta humañgale page, ta ihigup natdañgan di hi-numpkal. Adika mahduman. Ugikabo maginaginluk babui.

Wagahan daka babui te kinlum daka, te impañgadaka page ta monkakuyug-kayo page, hagaga, wiwik ya babui. Monudnud-kayo ud Dalom. Dulnangyo Bahiwag, hi Tinukud, hi Dumnan, hi Lutnak, hi Kaliog, hi Ginitu, hi Humamu. Imbagadaka babui dimatayanda he'a, nañgipadúanda, babui, ke he'a. Humapitka, babui 'Impaduyu-ak hi kolating.' Komali din bagol ta gumikud di page, ta humañgale page ta ihigup di natdañgan di hinumpkal. Adika mahduman. Ugi-kabo maginaginluk, babui.

Wagahan daka babui ta kinlum daka, te impañgadaka page, ta monkakuyug-kayo page, hagaga, wi-wik ya babui. Monuhaal ud Lagod. Dutnangyo Lukbuban, hi Binongbong, Alingdayu, Mongahid, Balud, Tugadan, Mañgali, Panikdapan, Púok, Nabalud, Dinumpitan, Binudbud. Imbagadaka babui, di matayanda ke he'a, etc.

Wagahan daka babui te kinlum daka, te impañgadaka page, ta monkakuyug-kayo page, hagaga, wi-wik ya babui. Monuhaal ud Paádan. Dutnangyo Kabigat, hi Dinipáan, hi Dumugung, hi Nalipang, hi Ambatugan. Imbagadaka babui dimatayanda ke he'a, etc.

The following is the first section of the above invocation:

| | | | | | | |
|---|---|---|---|---|---|---|
| *Wagahan* | *daka'n* | *babui* | *te* | *kinlum* | *daka* | *te* |
| Object-of-being-decorated-with-wreath-made-of-*hagaga*-grass,-stick-with-which-killed,-and-rice-heads | thou | pig | because | young-pig | thou | because |

| | | | | | |
|---|---|---|---|---|---|
| *impañgadaka* | *page* | *ta* | *monkakuyug-kayo* | *page* | *hagaga* |
| object sacrificed thou (to) | rice | in-order-that | agent-of-going-in-a-company-ye, | rice, | *hagaga*-grass |

| | | | | |
|---|---|---|---|---|
| *wi-wik* | *ya babui.* | *Tumalakdang-kayo* | *Kabunian.* | *Dutnangyo* |
| stick-with-which-killed, | and pig. | Agents-of-rising-ye (unto) | Sky-world | Objective-of-arrival-your |

| | | | | |
|---|---|---|---|---|
| *hudok nan Ampúal,* | | *Imbagádaka,* | *babui,* | *dimatayanda* |
| quarters of Ampual, | Balitian, etc. (as above) | Object-of-telling-thine, | pig, | agents-of-killing-they |

| | | | | | |
|---|---|---|---|---|---|
| *he'a;* | *nañgipaduanda* | *babui ke he'a* | *humapitka* | *babui* | *"Impaduyu-ak* |
| thee, | agents-of-sacrificing-they, | pig of thee: | Agents-of-saying. | thou, pig, | "Was-object-of-sacrifice- |

| | | | | | | |
|---|---|---|---|---|---|---|
| *hi* | *kolating"* | *Komali* | *din bagol* | *ta* | *gumikud* | *di page,* |
| at | the harvest-feast" | Agent-of-telling | the spirits | that | agents-of-increasing | the rice, |

| | | | | |
|---|---|---|---|---|
| *ta* | *humañgali* | *di page* | *ta* | *ihigup* |
| that | agents-of-increasing-miraculously | the rice, | in-order-that | object-of-being-brought (to) |

| | | | |
|---|---|---|---|
| *natdañgan* | *di hinumpkal.* | *Adika mahduman.* | *Ugikabo* |
| place-for-ripe-grain (of the granary) | the plenty. | Do-not-thou-be mute. | Do-not-thou-either |

| | |
|---|---|
| *maginaginluk,* | *babui.* |
| (emphatic) be-sleepy, | pig. |

harvesters, some of it is distributed to be carried home or cooked at will. Each of the priests gets a good piece. A most striking feature is the lack of variation in the process of cutting up and distributing the pig. The feet are first cut off. The children eagerly contend for these, and only the presence of the elders prevents them from coming to blows. Then the skin and fascia over the belly are cut off, the belly is opened and the entrails are taken out. The gall bladder is inspected for an omen. If it is full and dark—as it nearly always is, for the pig has not eaten for some eighteen to twenty hours—all is well.[62] The chest of the pig then is opened and the blood poured out. Some of the clotted blood is often snatched and eaten by the feasters, for they have fasted since night of the previous day. The triangular fascia under the lower jaw is cut off, the head severed from the body, and the body cut into sufficiently small pieces to go into pots.

The following is the apportionment of the parts of the pig: The head goes to the owner, for when the flesh has been eaten, the skull will be hung up outside the granary; the feet, pancreas, genitals, bladder, and a portion of the liver, to supply the children not already supplied with some part of the animal; the tail[63] to a child or to a man or woman who may desire it; the skin and fascia of the belly, the skin and the fascia under the lower jaw, the heart, and the lungs, to the cook, as pay for his services; the intestines, a highly prized portion, go to the youths who carry the rice to the granary; the remainder is divided among the harvesters and feasters.

I have never seen this allotment varied except in one case. In that instance, the cook, in cutting off the abdominal fascia, which rightfully fell to his lot, cut off some short ribs with it. The bystanders protested that the cook was taking more than his just portion and that he was, in fact, a pig himself.

*Continence and the fast during harvest time.*—While it usually takes only one or two days for a family, with the aid of relatives, neighbors, and the people who come down from the higher villages, to cut their rice, it is generally five weeks or more from the time the first family begins harvesting until the last one in the village has finished. During this

[62] After the examination, the gall bladder is twisted on a stick, and fixed under the floor of the granary. If by any chance it were empty and dark, it would be necessary to kill another pig.

[63] The tip of the tail, if it be white, is worn by a girl or woman in the hair as an ornament; and by a man at the end of the strings by which the neck ornaments are tied on. See the tips so worn by the dancers in the picture of the blanket dance. Plate VI, fig. 1.

time, continence is the rule for the following classes: Persons of importance, those who have a goodly number of rice fields; persons who take part in the harvest feasts, *monbaki;* and those who stack the rice in the granaries, called *mañgikapia.*[64] The reason given for this practice is that the *bagol* do not, at this season, approve of earthly pleasures and joys, and punish those who indulge in them not only by not increasing, but by actually decreasing their rice supply. I am informed that continence is strictly adhered to; and I believe that it is so, knowing, as I do, the implicit faith of the people in the tenets of their religion. And, besides this implicit faith, there is the consideration that the members of the three classes mentioned are middle-aged or elderly persons.[65]

During harvest time no Ifugao may eat of the carabao, ox,[66] deer, grasshopper, goat, fish, or snails. It is not forbidden to eat the flesh of the pig, chicken, or duck. Vegetables, except *camotes,* may not be eaten.

This renouncing present pleasures or advantages with the intention of gaining greater advantages of another kind is an old story in religions the world over. Self-denial is pleasing to the divinities; too much prosperity arouses the jealousy of the gods. Who are these mere men that they should have so much happiness? Let them pay for it!

It is very interesting to find in another Igorot tribe, living under very different conditions, an observance of celibacy and fast, from remarkably similar motives. The Igorots of Suyoc, in the Subprovince of Lepanto, live almost entirely upon the proceeds of their mining, the climate of their village not permitting the cultivation of rice. I am informed[67] that when a Suyoc man strikes, or knows that he is about

[64] This office is always performed by elderly men.

[65] The Eskimo have a similar practice during the whaling season. Says Elie Reclus: "During the hunting season, the Aleutians often turned their wives out of doors, forbidding them to cross the threshold of the great *kachim.*" * * * Primitive Folk, p. 58.

"Master whale is also a stickler for morality and virtue; he avoids latitudes frequented by base and dissolute tribes; does not approve of the whalers who have the honor of attacking him compromising themselves with women during the whaling season; he would even punish them by some terrible chastisement if their wives were unfaithful to the conjugal vow during their absence; he would cause them to perish by a cruel death if their sisters failed in chastity before marriage." *Ibid,* p. 55.

[66] In Mayaoyao village the ox is regarded as unclean, and the use of its flesh as food is interdicted altogether by custom. For this information I am indebted to Lieutenant-Governor Jeff D. Gallman.

[67] I am indebted for this information to Major C. E. Nathorst, Philippines Constabulary, and to Mr. Henry Reeder.

to strike, a vein of gold-bearing rock, he quits work, goes home, and offers to his gods a feast lasting two or three days. From the time that he returns to work until the vein or pocket is exhausted, he drinks no rice wine, and eats no flesh nor vegetables. He also remains continent. The reason he gives for this practice is that, otherwise, the spirits would get angry, and would cause the gold-bearing rock to diminish rapidly, and soon to fail altogether. Note the parallelism of the customs and the motives thereof, although the Suyoc man is working his "find" of ore, and the Kiangan man is cutting his rice crop.

# ILLUSTRATIONS.


PLATE I.

FIG. 1. Two granaries. General view of the feast.
2. Invocation of the ancestral spirits. Note the position of the hands above the forehead. This is characteristic.

PLATE II.

FIG. 1. The drum. Note *runo* decorated with feathers, betel nuts, etc.
2. A recess between ceremonies.

PLATE III.

FIG. 1. Ceremonial drinking of rice wine. This picture is a pose, and does not begin to indicate the fervor of the feasters during the ceremony.
2. Summoning the *tayaban* with bamboo shakers or *palipal*. (Monligid.)

PLATE IV.

FIG. 1. Man in attitude of shaking *palipal*. Note the shelf for seed rice to the left.
2. Summoning the *púok*.

PLATE V.

FIG. 1. House of the *pili*, a spirit that guards the granary against thieves. Note offering of betel nuts and chicken flesh on the short stick of *runo*.
2. The procession during the summoning of the Bakayauan.

PLATE VI.

FIG. 1. The blanket dance.
2. Ceremonial killing of the pig. The children begin to be in evidence.

PLATE VII.

FIG. 1. Singeing the hair and epidermis. Note the *runo* plug in the pig's breast.
2. Dispatching the spirit of the pig. A pose. Note the ceremonial wreath. In this case *runo* blades were used instead of *hagaga*.

PLATE VIII.

Kiangan rice fields.

FIG. 1.

FIG. 2.

PLATE I.

FIG. 1.

FIG. 2.

PLATE II.

FIG. 1.

FIG 2.

PLATE III.

FIG. 1.

FIG. 2.

PLATE IV.

FIG. 1.

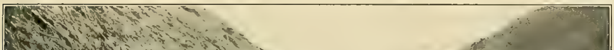

FIG. 2.

PLATE V.

FIG. 1.

FIG. 2.

PLATE VI.

FIG. 1.

FIG. 2.

PLATE VII.

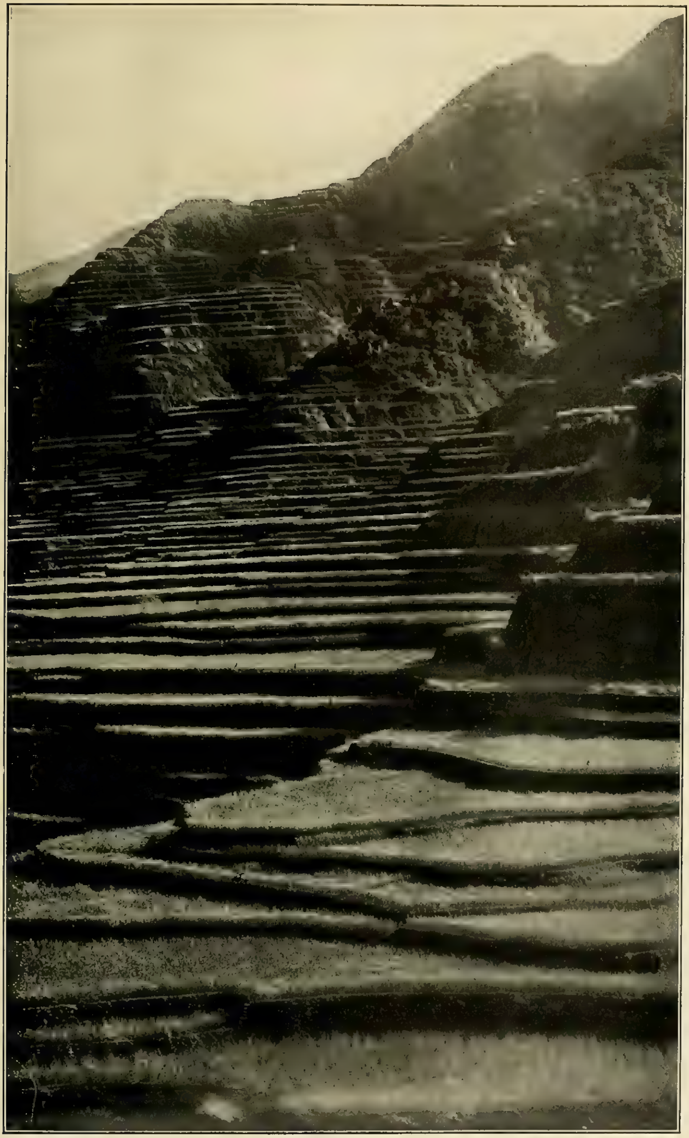

PLATE VIII.

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# FILIPINO EARS: III. NEGRITO.

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The Negritos of the Philippines have been studied at close range by Meyer, Montano, Reed, and others, and from a distance by many anthropologists, including Virchow and Blumentritt. Dean C. Worcester, Secretary of the Interior, has visited Negritos wherever they exist in the Archipelago, and it is through his generosity in placing at my disposal the photographs of his inimitable collection and of the Bureau of Science, from which materials are drawn for this and subsequent studies of the non-Christian tribes, that I am enabled to produce this publication.

This is the first of a series dealing with the ears and other physical characteristics of the Philippine Islanders of the interior, and follows studies previously completed of the ears of Manila pedestrians and riders, Bilibid prisoners, morgue subjects, and the men and women of Taytay, Rizal Province, Luzon.

The Negritos are the first of the non-Christian tribes selected for study, (1) because they are relatively few in number and, undoubtedly, are gradually disappearing, since they lose their purity when they come into contact with surrounding peoples; (2), because very few studies of Negritos have been made dealing with the physical characteristics of the living; (3), because no previous study has been made of their ears; and finally (4), because a large number of representative photographs of Negritos from many parts of the Islands could be obtained.[1]

[1] The photographs have been derived from several sources, and have been taken at various times by different men, therefore some difficulty has been experienced in reproducing them uniformly. The photographs of the Negritos of Bataan or Mariveles Mountain, of Isabela and Pampanga Provinces, and some of those of Palawan Island and elsewhere, were taken by Dean C. Worcester. The Negritos of Zambales were photographed by William A. Reed and others; those of Cagayan by Charles Martin, of the Bureau of Science; the Tinitian and others (Bataks) in the Island of Palawan by Lieutenant E. Y. Miller while he was governor of Palawan Province; and the photographs of the Negritos of the Island of Panay, Provinces of Antique and Capiz, and Ambos Camarines, Luzon, were taken by Doctor M. L. Miller, chief of the division of ethnology, Bureau of Science. These are groups from which photographs are presented, with the addition of a few others.

It is to be noted that Negritos still remain in the Philippines, from Palawan in the south to the extreme northern end of Luzon. Not only is the distribution of the Negritos general throughout the Islands, but the types selected show a similar general distribution, although slight local resemblances exist. The Negritos of a single locality have evidently inbred, yet the possibility of intermixture with the surrounding populations can in no instance be disregarded.

The literature dealing with the Negritos is not available. The monumental work of Meyer has not been accessible, and the only available publications dealing with physical measurements have been limited in the number of individuals measured. The work of Reed [2] represents fairly well the Zambales Negritos in a series of photographs which is a most complete portrayal of a single group, but the physical characteristics are otherwise not treated fully. This is the first attempt ever made, in the manner of this study, to analyze the types of a group of individuals from photographs, and although I present the results with some trepidation, yet I believe my previous studies of the ear and the use of descriptions rather than measurements, enable me to characterize the types with a fair degree of accuracy.

### DESCRIPTION AND CLASSIFICATION OF TYPES.

Before beginning the study of the Negrito ears, it may be well to describe the typical Primitive and Iberian ears and physiognomy, because they represent fundamental Negrito types.

Primitive ears are characterized essentially by the inrolled helix with inversion of the concha. This gives the appearance of a hollow bowl with the rim prominent at the upper part of the helix and at the lobule, and depression of the bowl's rim at the ventral and dorsal parts of the ear. A shelf is thus formed both above and below, the internal part of the superior border of the helix forming the superior surface of the upper shelf, and the external part of the lobule the superior surface of the lower shelf. The concha is short in its vertical, and wide in its horizontal, diameter, although this is not invariably true.

Iberian ears are marked essentially by the eversion of the concha and the consequent turning back of the helix, particularly in its lower half. This results in an old-English small-letter *f*-shape of the helix rim as viewed from behind. The lobule is pendant or turned backward toward the head, and frequently is absent as in type B, or square as in type C, in contrast with the lobule of the Primitive, which is turned forward and upward, this point alone often being sufficient to distinguish either of the two types of ears.

[2] Negritos of Zambales, *Ethnological Survey Publications*, Manila (1904), 2, pt. 1.

The Primitive ear is usually round, the Iberian, long. The physiognomy of the Primitive, in general, is broad and flat. The forehead is small and prominent, the brow ridges insignificant. The nose is broad, flat, and depressed at the bridge, which is often totally lacking. The nostrils open somewhat forward rather than downward. The mouth is not wide, but the lips are thick, and the chin is small and receding.

The physiognomy of the Iberian is in every characteristic almost the reverse of the Primitive. The face is long, narrow, and projecting, with considerable facial prognathism, with an acute angle formed by lines joining the glabella with the external auditory meatus. The forehead is square and the brow ridges small. The nose is narrow, high, and long. The nostrils point downward, and do not flare. The mouth is not large, and the lips are thin. The chin is pointed, but often projects slightly instead of receding. The chin and forehead of the Iberian and Primitive are not so unlike as are the other features, the great differences between the two faces being in the middle parts, where width and flatness in the Primitive and narrowness and projection in the Iberian are the distinctive characteristics.

## ANTHROPOLOGICAL TYPES ILLUSTRATED BY PHOTOGRAPHS OF EARS.

### Plate I.

The two fundamental ear types, Primitive and Iberian, that characterize the Filipinos wherever I have examined them, apparently form basic types of Negrito ears. These two types of ears on both man and woman may be seen in Plate I. Figures 1 and 2 represent a characteristic Negrito woman of the Primitive type from Mount Mariveles, Bataan Province. But for the bushy head of hair, this photograph would well represent a Primitive Filipino such as may be seen in almost any part of the Islands. The ear can not be seen well but enough of it is shown to reveal the Primitive characteristics. The shelf lobule is seen on the right ear, and the rounded contour, with overturned helix on the left. Other Primitive traits may be seen, such as the broad, flat nose with depressed ridge, flaring nostrils, and apertures that open forward instead of downward; the vertical, or *bombé,* forehead that is particularly small in its transverse dimension; the thick, projecting lips; and the small, receding chin.

The two men of figures 5 and 6 are not so typical of the Primitive as is the woman, but they approach the form more closely than any other male Negritos portrayed. The Negrito men in general are not of the Primitive type, but the majority of the women are of this type, a statement that will become evident as the study progresses.

The woman of Zambales in figures 3 and 4 is said to be Negrito, and if that be true the pure Negrito is a Modified Iberian. The ear has a combination of Primitive and Negrito characteristics. The inrolled,

overturned helix is Primitive, and the slightly everted concha below and pendant lobule suggest the Iberian. The nose is straight, not very wide and flat, and the other features of the physiognomy resemble the Iberian as much as the Primitive. However, this woman is not so good a representative of the Iberian Negrito as the man of Zambales portrayed in figure 8, who is almost a typical Iberian. The ear is long with pendant lobule, everted concha, and spiral helix. The nose is long and straight, and the other features resemble the Iberian. The hair is curly, rather than kinky, and I venture to state that this is a European-Negrito cross.

The man of figure 7, also seen in figures 1 and 2, Plate II, is called by title in Mr. Worcester's catalogue "an excellent type," yet this man has Iberian ears and physiognomy. It is true that they are not perfect Iberian, but the ear has an everted concha, slightly spiral helix, and somewhat dependent lobule. The nose is straight and somewhat pointed. Other features resemble the Iberian.

### Plate II.

The remainder of the Negritos represented in Plate II are also of the Iberian type. Figures 3 and 4 are photographs from the negatives used by Keane on pages 220 and 222 of The World's Peoples to represent a Negrito of the Philippines. The ear can not be seen well but presents the everted concha and pendant lobule characteristic of the Iberian, and the sharp, straight nose, and other characteristic features also denote the Iberian. Keane also gives a picture of "Ardi, one of the last of the Kolangs," the aborigines of Java, whose ear is Iberian in type, not unlike that of the Negrito in Plate I, noted by Mr. Worcester as "a full-blood." The physiognomy of Ardi, who is called by Keane "the most ape-like of men," is that of a degenerated Iberian.

Figures 5 and 6 are rather good photographs of Pagatolan, a Negrito chief of Isabela, who "has had three albino children, two of whom are living and to one of whom he had given Christian baptism. He states that God has been very good to give him white children, and that he proposes to send them to school." This Negrito is decidedly Iberian. The long, straight, pointed nose, the pointed chin, and the square forehead are all evidences of the Iberian. Unfortunately the ears do not show well, although the lobule and lower helix and concha resemble the Iberian. The albino children may be expressions of Mendelian heredity from a previous European-Negrito cross.

Figures 7 and 8 represent a Negrito said to be of pure type (Reed, Plate XII), but again the Iberian is evident. However, the ear is not of unmixed type and the Iberian traits are not very well marked, although the concha is everted, and the lobule is square.

### Plate III.

This plate exhibits Negrito women of the Primitive or Modified Primitive types from Ambos Camarines, Mount Mariveles, and Palawan Island. It is needless to point out the Primitive characteristics, but the broad, flat nose with depressed bridge and nostrils that open more forward than downward, and the shelf-like lobule of the ear may be seen on each individual.

It may be of interest and significance that the Negrito women shown in all the photographs are almost entirely of the Primitive type, whereas the men are Iberian. If Pearson's law be true, that males inherit more from the father's side and females from the mother's, then the men who have impregnated the Negrito women were of the Iberian type and the impregnated women were of the Primitive.

### Plate IV.

The Negritos portrayed in Plate IV are variable blends of the Iberian and Primitive. Figures 1 and 2 represent a purer Iberian ear than the others. The concha is everted, the lobule attached directly to the cheek at its lower margin, and there is a slight outward twist of the upper part of the helix. The other features are blended, although the nose is slightly aquiline. Figures 3 and 4 represent a less pure Iberian ear than figures 1 and 2. The ear has a Primitive bend or knee at the junction of the lower and middle thirds, and the lobule tends to form a shelf, but does not quite perfect the tendency. The nose is large and straight and the other features are neither perfect Iberian nor perfect Primitive. The Negrito of figures 5 and 6 is less Iberian and more Primitive than the one of figures 3 and 4. The ear is very slightly Iberian in the eversion of the concha and slightly spiral helix, whereas the Primitive characteristics are marked in the rounded contour, outward, overturned, upper helix, and shelf-like lobule. The other features are blended Iberian and Primitive.

The Negrito of figures 7 and 8 is very slightly Iberian, although the nose is somewhat straight and the nostrils open downward. The ear is blended, with Primitive characters predominating.

### Plate V.

Plate V presents variable, female blends. However, each partakes largely of the Primitive type, and in none is the Iberian very well marked. Figures 1 and 2 show almost pure Primitive ears, although the nose is not Primitive. Figures 7 and 8 show forms simulating Iberian, but the Primitive ear is still apparent. The forms of figures 3, 4, 5, and 6 are blends of varying nature more or less intermediate between those of figures 1 and 2, and 7 and 8. The women again present Primitive, and the men Iberian, characteristics in the blends as in the purer types.

PLATE VI.

However, Iberian characteristics may appear in hybrid, female Negritos. Evidence of this is furnished in Plate VI, figures 1 and 2, which represents an old Negrito mestiza. The left ear is almost typical Iberian, with everted concha, pendant lobule, and spiral helix, whereas the right ear is somewhat more Primitive in character, with a slightly shelf-like lobule and overturned superior helix, although the latter may be due to pressure from the overhanging hair. The nose is straight and neither very wide nor flat, and the skin appears light in color.

In figures 3 and 4, Iberian characteristics of the ear also appear, although less marked than in figures 1 and 2, but the other Iberian characters, although present to some extent, are not so well seen.

Figures 5, 6, 7, and 8 are placed alongside each other to illustrate two old Negritos with Modified Primitive characteristics.

PLATE VII.

Other ear types, besides the Primitive and Iberian and their blends, appear among the Negritos. The Alpine ear of the same nature as that observed on many Filipinos other than Negritos may be seen in Plate VII. Figures 1 and 2 represent a so-called pure Negrito of Ambos Camarines. The ear is Alpine, having a shelf-like lower helix inserted diagonally downward into the cheek. The ear does not form a double shelf above and below by the turning in of the helix at its upper and lower parts, but there is a slight turning at both ends which indicates Primitive characters. There is also a slight spiral twist to the helix, an eversion of the concha, and the insertion of the lower helix or lobule which suggests the Iberian. Therefore this ear must be considered as an intermediate form of the Primitive and Iberian, retaining qualities of both, yet different from either, forming a kind of mosaic, which is a true ear-type.

The physiognomic characteristics of this man are also intermediate between the Iberian and Primitive. The nose is neither broad and flat nor long and straight, the forehead is both square and *bombé;* the lips are not full, nor is the chin markedly receding. Figure 5 represents another Negrito man from Ambos Camarines; here the ears are also Alpine, although slightly more like the Primitive than in the other Negrito from the same place.

The Negrito man of figure 6 is also a Camarines native with Alpine ears, in which the Iberian qualities somewhat overshadow the Primitive.

The other features of the two men are those of the Alpine type, either a blend of Iberian and Primitive or a mosaic of the two. The four remaining figures (3, 4, 7, and 8) of Plate VII probably represent crosses between the Negritos and neighboring Malays, and they portray men of the Alpine type. The character of the ears and physiognomy

of the man in figures 3 and 4 is nearer the Iberian than the Primitive, and the same features of the man in figures 7 and 8 are nearer the Primitive than the Iberian.

### Plate VIII.

Plate VIII illustrates variable forms resembling the Alpine, although none are perfectly true types, but rather a group of atypical, Alpine ears resembling both Primitive and Iberian, some more like one type and some more like the other. Figures 1 and 2 represent a Mariveles Negrito man more Iberian than Primitive; figures 3 and 4 represent a Negrito man from the Island of Burucay, a part of the Province of Capiz, off the northwestern point of the Island of Panay, who is more Primitive than Iberian. The man in figures 5 and 6 is a Negrito from Casablanca, Cagayan Province, northern Luzon, who is probably also more Primitive than Iberian. Figure 7 is almost an Iberian, and figure 8 is almost a Primitive; the one, a man from the Island of Burucay, "with considerable Visayan blood," and the other, the "chief of the Mariveles tribe, who is a typical Negrito, and, like many of the men of his tribe, has quite an abundant growth of hair on the face."

The many forms of blended ears intermediate between the Iberian and Primitive belong to the Australoid type wherever the ear form is not that of the Alpine. The Negrito-Australoid is not unlike the Filipino-Australoid from different parts of the Islands, and the characteristic, large, straight nose may be seen on practically all the photographs of this type. It is well marked in all the figures of Plate VIII.

### Plate IX.

The Australoid nose may be seen clearly in figures 1, 2, 3, and 4, Plate IX, and somewhat modified in figures 5, 6, 7, and 8 of the same plate. The ears are all modified Primitive, and may be called Australoid ears.

### Plate X.

The ears previously described in this study have been similar to those of other Filipino populations throughout the Archipelago and no distinctive Negrito ear has been demonstrated. However, there is a type of ear that is presented as the true Negrito ear, although it may prove to be only a variant of one of the forms previously described, or it may be Australoid. It is seen distinctly in figures 1, 2, 3, and 4 of Plate X (and in figs. 3 and 4 of Pl. IV), in combination with the Australoid nose. It is seen in modified form in figures 5, 6, 7, and 8, where the nose is also somewhat modified. The characteristic of this ear is the offset in the helix at the point where the lobule begins. This is in the form of an indentation on both the ventral and the dorsal surface of the helix, and gives a shelf similar to that of the Alpine ear, although the lobule does not pass immediately to the cheek, but projects downward

and forward in a rigid, rounded point. This ear form is simulated by many that have Primitive characteristics, as may be seen in Plate A where the three Negritos from Pampanga have this ear type. The Australoid nose is especially plain in the man in the center of Plate A.

### Plate XI.

The true Negrito ear is seen in modified form in all the figures of Plate XI where the nose is not typically Australoid, but also modified. Observations of living Negritos, with physical measurements, may be necessary to determine the relation of this ear to the physical type. At present it appears to be one of the most frequent forms and apparently the true ear-type. It may be regarded as a blended type derived from the Primitive and Iberian which has been differentiated from both in the processes of fusion.

### Plate XII.

Plate XII is presented to illustrate the results of combinations of types that have intermingled, and thus enables us to understand the processes by which amalgamation progresses. Figure 1 is an Iberian Filipino with perfect, Iberian, type A of ears, probably a Spanish-Filipino mestizo. If such a man should impregnate a Negrito woman of the Primitive type seen in figure 2, the result might be the production of two individuals similar to those in figures 3 and 4, where blending is evident. The further impregnation of Negrito women by such blended individuals might produce men similar to those portrayed in figures 5, 6, 7, and 8, in which the kinky hair and dark skin of the Negrito appear because they are dominant, and in which the Iberian and Primitive ears and physiognomy remain blended to some extent, although one may partake more of the Primitive and another of the Iberian. The union of individuals of the blended type might also reproduce according to Mendel's law; the offspring would then be in the ratio of three Negrito Primitives to one Filipino-Iberian, provided the former is dominant.

### DISCUSSION.

Three possibilities in the heredity of Iberian and Primitive characters are apparent from the study of the ears and physiognomy of the Negritos: First, there is blending with the production of a hybrid that has curly or wavy hair, ears that are part Iberian and part Primitive without the distinctive characters of either, and a nose that is straight, yet wide and not high; second, there is persistence of both Iberian and Primitive ears and physiognomy, each type accompanied by kinky hair; third, there is a mosaic ear, the Alpine, some parts of which are Primitive and others Iberian, and which, slightly modified, occurs in connection with kinky hair and Iberian physiognomy.

It remains to be determined exactly what takes place in the heredity

of cross-bred races such as the Iberian and Negrito, or the Filipino and Negrito, but the indications are that there is blended heredity, mosaic heredity, and persistence of type which suggests Mendelian heredity. There exist among the Negritos forms of hair, nose and ear, as well as other features of the physiognomy, intermediate at almost every conceivable point between the widest extremes, and the general effect is that of disorderly blendings as represented previously by a scheme for heredity of type.

Several suggestions seem pertinent. The Negrito was originally of the Primitive type and contact with the Iberian has resulted in the production of various new forms, such as the Alpine and Australoid, with the retention of the two other types, Primitive and Iberian; or the Negrito was originally of the Australoid type and has been impregnated with the Primitive and Alpine through the Malay migrations, and the Iberian through the Spanish occupation of the Philippines, with the retention of these types and the formation of intermediates between them; or, the Negrito was originally Iberian and has become mixed with Primitive, Alpine, and Australoid forms through subsequent infusions from various sources; or, the Negrito was originally of a composite form embodying the Primitive, Australoid, and Iberian, from which these and other types have arisen; or, the true Negrito form has become lost through incessant intermingling, leaving only the small size, dark skin, and kinky hair; or, the Negrito represents a degenerated product with many possible forms tucked away under the kinky hair and dark skin; or, various combinations of all these suggestions may be the truth.

Whatever may have been the conditions, there can be no doubt that the Negrito of the Philippines is not a pure race, but one composed of at least two forms, the Primitive and the Iberian, which are almost exact antitheses in the cardinal anthropomorphic qualities, and of the Australoid, which is a combination of the two forms.

The most plausible hypothesis as to the composition of the Negritos is that they were originally of the Primitive type, and subsequently became impregnated with the Iberian, because the women are largely of the Primitive type and the men of the Iberian. The Iberian impregnation must have come at a time previous to the Spanish possession of the Islands, or at least it was other than Spanish or even than Filipino or Chinese, or else there would be found Negrito types similar to the Adriatic, Cro-Magnon, and B. B. B., all of which are present in the living Spanish, Chinese, and Filipino population of the Philippines, unless it be that these types, which are greater in size than the Iberian, are incapable of impregnating the Negrito and fecundity is possible only with the Iberian. It is probable that the Iberian and Primitive united in the Negrito before their arrival in the Philippines, or at a very

early period in the Philippines before the arrival of the first Malay migration; therefore, their origin should be sought elsewhere, probably in Asia.

Davenport's hypothesis, that straight hair is recessive and kinky or curly dominant, is corroborated by finding many straight-haired forms, such as the Iberian and Primitive, with kinky hair, although blending in hair-form is evident among the mixed Malay Negritos. This does not necessarily imply that straight hair would not be dominant and curly hair recessive under different conditions, as among the other peoples of the Philippines not Negritos, where the kinky hair of the Negrito has probably often appeared and, I believe, disappeared. Probably the truth of the matter is that when two extremes of hair-form are crossed, such as the Malay and Negrito, the first results are blends, with afterwards a return, more or less pure, to the original forms; but in the end the kinky hair of the Negrito is retained when the cross takes place continually among the Negritos, and the straight hair when the crossing is continually among the Malays. In this manner extraneous types are bred out.

The photographs of the Mariveles Negritos were all placed upon a large table before me, and when I scrutinized them carefully I realized that I was looking into the familiar faces of a people among whom I was born and with whom I grew up. Practically every face recalled youthful associations, and every individual of the Mariveles group has its counterpart among American Negros.

The photographs of the Negritos from other parts of the Philippines were likewise disposed upon a large table, replacing the Mariveles Negritos; the familiar faces of the homeland vanished, but in their places appeared the faces that one meets every day in Manila or in the provinces, familiar Filipino types. A few of them still resemble the American Negro; this is particularly true of the Negritos of Isabela Province.

These casual observations must be taken with reservations, because no data can be given to substantiate them; but I believe they indicate a close relationship between the Negrito of the Philippines and the African Negro.

## ANTHROPOLOGICAL TYPES ILLUSTRATED BY FULL-LENGTH PHOTOGRAPHS.

### PLATE XIII.

Plates XIII to XVII represent the full figure of Negritos, and most striking differences may be seen in the length of the lower extremities of different individuals, and in different groups. The six Mariveles Negritos in Plate XIII have relatively long lower extremities; one is a very tall Negrito, his stature being due to his great leg length. This man is as tall as the average European, judging from the photograph taken by the side of Dean C. Worcester, who writes, "this is the tallest Negrito man I have ever seen."

The Mariveles Negritos are mixed Iberian or Australoid in type without exception, all having the big, straight nose characteristic of the Australoid.

PLATE XIV.

The Negritos of this plate decrease in the relative length of the lower extremity from left to right, and the type varies from Australoid to Primitive with the decrease of relative leg length. The two Negritos on the left, figures 1 and 2, are Australoid or Modified Iberian, the two on the right are Primitive or Modified Primitive, and the two in the center are intermediate forms. The Negrito of figure 1 is from Mariveles Mountains and the Negrito of figure 6 from the neighboring Zambales Mountains, but in spite of the proximity of their abodes they are very unlike. The differences apparent here are the long legs, face, and nose of the Mariveles Negrito and the short legs, short, wide nose, and short, wide face of the Zambales Negrito. These differences indicate Iberian affinities for the Mariveles Negrito, and Primitive for the Negrito of Zambales. The differences are apparent, not only in these two individuals, but also in the two groups from the Provinces of Bataan and Zambales. Negritos from other parts of the Islands resemble one or the other group, but are usually intermediate, and represent greater blending with the surrounding population.

PLATE XV.

The Zambales Negrito of figure 2 with short legs is here contrasted with a Negrito of Cagayan Province in figure 1 with intermediate leg length and a Negrito of Isabela Province in figure 3 with long legs. The Zambales Negrito is almost pure Primitive, the Isabela Negrito almost pure Iberian, and the Cagayan Negrito is intermediate in type, the result of Malay or Igorot mixture rather than Negrito. The small Negrito boy of figure 5 with short legs may be contrasted with the old Negrito man of figure 4 with intermediate leg length. This boy is from Cagayan, and when full-grown would probably have legs of intermediate length. An illustration of three small Negrito boys of Mariveles Mountain would have been presented showing long legs in youth, although relatively not so long as those of the adult Negritos of Mariveles, but the photograph was not good enough for reproduction. One may infer from this that relatively short legs represent a youthful condition, but the relative length of individual development is not enough to overcome that of conditions due to type, at least in this instance. In other words, phylogeny is of stronger or greater extent than ontogeny. There is a greater difference between the Mariveles Negritos and the Negritos of Cagayan than between the men and the boys of Mariveles or between the men and the boys of Cagayan.

### Plate XVI.

The Negritos shown on Plate XVI are all mixed with the surrounding peoples and partake of their characteristics. The leg length is intermediate, although the central figure, a Negrito from Cagayan, has relatively shorter legs than the others.

### Plate XVII.

The Zambales Negritos shown on Plate XVII are very much mixed in type, and the variable length of leg indicates the mixture as much as any other character. The men on the right of each figure have shorter legs than the others, and the man next to the one on the left in figure 1 and the one next to the right in figure 2 have longer legs. Here, as elsewhere, the Primitive characteristics go with short legs and the Australoid with long legs.

### SUMMARY.

The Mariveles Negritos, who are apparently purer in type than any other group and who are largely of the Iberian and Australoid types, have relatively longer lower extremities than any other group of Negritos represented by photographs; the Zambales Negritos, who are largely mixed and of the Primitive type, have relatively shorter lower extremities than any other group; and the remaining groups, who are also much mixed and intermediate between the Iberian and the Primitive, have lower extremities of intermediate length.

It would appear from the photographs of the full figure that the purest Negritos are to be found in the Mariveles Mountains, and these Negritos are of the Australoid type, which is probably a combination of Iberian and Primitive that has almost reached the stage of complete amalgamation. The Iberian characteristics are more or less pure in some individuals, the Primitive are likewise more or less pure in some, but the greater part represent a complete blend of the Iberian and Primitive that conforms to the type previously designated by me as Australoid, which is found among the Igorots and all the littoral Filipinos so far examined.

### CONCLUSIONS.

Any conclusion reached after a study of the photographs presented must be tentative and subject to revision. However, it does appear that there are many inseparable factors in the composition of the individual, such as the ear form, nose and face form, length of the extremities, that constitute a *character-complex* which exists as an entity and in inheritance may act as a unit character.

A character-complex is that group of characters, such as the broad head, broad nose, broad face, and characteristic ear that, combined with small stature, constitute the Primitive species, which character-complex usually hangs together in heredity, but may break up to form new character-complexes.

There is blending of one character-complex with another, but this blending probably does not take place at once upon crossing two extremely different character-complexes such as the Iberian and Negrito, but results in the reappearance of one or the other character-complex in pure form as shown in figure 8, Plate I, where the true Iberian is obscured by having kinky hair and dark skin.

From this follows the second conclusion, which is that the kinky hair is dominant to the straight hair when the cross takes place among the Negritos, therefore a character-complex may be obscured by the kinky hair, so that an otherwise pure Iberian may appear to be a Negrito because of the character of the latter characteristic.

The Negritos of Mariveles Mountain appear to be the purest Negritos in the Philippine Islands, judging from the photographs. All other groups of Negritos are more like the surrounding population. Therefore, the Negritos of Mariveles should represent the fundamental Negrito type, and, as they are largely Australoid, the fundamental type of the Negritos should be Australoid. However, the Australoid is composed of the Primitive and Iberian types which have fused in a disharmonic manner, forming a mosaic. Modified Primitive and Modified Iberian Negritos are also found in the Mariveles group. The women are more Primitive than the men, who are more Iberian and Australoid than the women. The Primitive and Iberian characteristics of the Mariveles Negritos are of such a nature that they should be considered as remnants of the fusion which must have progressed for many centuries or even thousands of years to have produced so homogeneous a blend.

May it be presumed that the Primitive and Iberian types conjoined in prehistoric times at some place in eastern Asia or near by, and by fusion produced the Negrito? From this union innumerable offshoots have sprung in southern Asia, in the islands bordering that region, and also in Africa. The Primitive type remains pure in parts of the East, and the Iberian in Europe. If this hypothesis be untrue, the reverse of it should be considered: The Negrito forms the basic stock of all humanity, and the Iberian of Europe on the one side and the Primitive of the Orient on the other are derivatives. If neither hypothesis be *workable,* then the Negrito of Mariveles has Primitive and Iberian characteristics ingrafted from without. Whatever may be the cause of the condition, there are three types found among the Negritos: the Australoid, the Primitive, and the Iberian; and these three types are found also among all the other peoples of the Philippines wherever I have examined them. The Primitive and the Australoid types, and doubtless the Iberian, are found in all the islands of the Pacific where search has been made and careful analysis of the people has followed.

The more profound the study of mankind, the more profound becomes the impression that the Primitive and Iberian are two fundamental types.

# ILLUSTRATIONS.[1]


PLATE A. TRUE NEGRITO EARS.

FIG. 1. Negrito man of Pampanga Province, showing pointed teeth. (Photograph by Worcester.)
2. Negrito man of Pampanga Province. (Photograph by Worcester.)
3. Negrito woman of Pampanga Province, showing pointed teeth. (Photograph by Worcester.)

PLATE I. MODIFIED PRIMITIVE AND IBERIAN NEGRITOS.

FIGS. 1 and 2. Front and side views of head of full-grown Negrito woman of Bataan Province. Primitive. (Photograph by Worcester.)
3 and 4. Front and side views of head of Negrito woman of pure blood, of Zambales Province. Modified Iberian. (Photograph by Worcester.)
5. Pure Negrito of Ragay, Ambos Camarines Province. Lives near town and works for Filipinos. Primitive. (Photograph by Worcester.)
6. Head of full-grown Negrito man of Bataan Province. This man is a full-blood and is an excellent type. Modified Iberian. (Photograph by Worcester.)
7. Head of Negrito man of Zambales Province. Modified Primitive. (Photograph by Worcester.)
8. Side view of a Negrito man of mixed blood, of Zambales Province. He evidently has had the back of his head shaved but the hair has begun to grow again. Iberian. (Photograph by Diamond.)

PLATE II. MODIFIED IBERIAN NEGRITOS.

FIGS. 1 and 2. Front and side views of full-grown Negrito man of Bataan Province. (Photograph by Worcester. See Plate I, fig. 6.)
3 and 4. Front and side views of Negrito man of Zambales Province.
5 and 6. Front and side views of head of Pagatolan, a celebrated chief among the Negritos of Isabela Province. (Photograph by Worcester.)
7 and 8. Front and side views of head of an old Negrito of Zambales Province.

PLATE III. PRIMITIVE NEGRITOS.

FIG. 1. Negrito woman at Ragay, Ambos Camarines Province. (Photograph by Miller.)
2. Negrito woman near Batobalani, Ambos Camarines Province. (Photograph by Miller.)
3 and 4. Front and side views of head of Negrito woman near Batobalani, Ambos Camarines Province. (Photograph by Miller.)


[1] The descriptions used in these illustrations are taken from Mr. Worcester's catalogue.

FIG. 5. Side view of head of typical Negrito woman, Bataan Province. (Photograph by Worcester.)

6. Negrito woman near Batobalani, Ambos Camarines Province. (Photograph by Miller.)

7. Batak woman (type 8), Palawan Island. Profile view. (Photograph by Worcester.)

8. Profile view of young married Negrito woman of Bataan Province who is suffering from a scaly disease of the skin common among the wild tribes of the Philippines. (Photograph by Worcester.)

PLATE IV. VARIABLE BLENDS OF PRIMITIVE AND IBERIAN NEGRITOS.

FIGS. 1 and 2. Captain Fernando del Barco. Negrito man near Batobalani, Ambos Camarines Province. Modified Iberian. (Photograph by Miller.)

3 and 4. Side and front views of chief of the Mariveles tribe of Bataan Province, who is a typical Negrito, and like many of the men of his tribe, has quite an abundant growth of hair on the face. Blend. Australoid? (Photograph by Worcester.)

5 and 6. Front and profile views of young Negrito man, Bataan Province. Blend. (Photograph by Worcester.)

7 and 8. Front and side views of Negrito man, Capiz Province, Panay, of nearly or quite full blood. Modified Primitive. (Photograph by Miller.)

PLATE V. VARIABLE BLENDS OF IBERIAN AND PRIMITIVE NEGRITOS.

FIG. 1. Profile view of Negrito woman of Zambales Province. Modified Primitive.

2. Side view of young unmarried Negrito girl of Bataan Province. Modified Primitive. (Photograph by Worcester.)

3. Side view of Negrito girl of Zambales Province. Blend. (Photograph by Diamond.)

4. Side view of middle-aged Negrito woman of Bataan Province. Blend. (Photograph by Worcester.)

5 and 6. Front and side views of Negrito woman, Cagayan Province. Blend. (Photograph by Martin.)

7. Old Negrito woman of Zambales Province. (Photograph by Miller.)

8. Side view of Negrito woman of Pampanga Province. Modified Iberian. (Photograph by Worcester.)

PLATE VI. MODIFIED IBERIAN AND PRIMITIVE NEGRITOS.

FIGS. 1 and 2. Front and side views of old Negrito woman of Cagayan Province. Modified Iberian. (Photograph by Martin.)

3 and 4. Front and side views of Negrito man near Batobalani, Ambos Camarines Province. Modified Iberian. (Photograph by Miller.)

5 and 6. Front and side views of a very old Negrito woman of Bataan Province. Primitive. (Photograph by Worcester.)

7 and 8. Front and side views of an old Negrito man of Zambales Province. Primitive.

PLATE VII. NEGRITO ALPINE EARS AND TYPES.

FIGS. 1 and 2. Front and side views of pure Negrito of Ragay, Ambos Camarines Province. Lives near town and works for Filipinos. (Photograph by Miller.)

3 and 4. Dumagat man of Kalawat, Kalawat Island. Probably a cross between Negrito and Malay. (Photograph by Miller.)

FIG. 5. Negrito man at Batobalani, Ambos Camarines Province. (Photograph by Miller.)

6. Negrito man at Ragay, Ambos Camarines Province. (Photograph by Miller.)

7 and 8. Front and side views of young Batak man (Type 1) of Tinabog, Palawan Island. Note the typical hair-cut. (Photograph by Worcester.)

PLATE VIII. VARIABLE ALPINE NEGRITOS.

FIGS. 1 and 2. Front and side views of old Negrito man of Bataan Province. (Photograph by Worcester.)

3 and 4. Front and side views of Negrito man of nearly or quite full blood, of Capiz Province, Panay. (Photograph by Miller.)

5 and 6. Front and side views of Negrito man of Cagayan Province. (Photograph by Martin.)

7. Side view of Negrito man of Capiz Province, Panay, with considerable Visayan blood. (Photograph by Miller.)

8. Side view of chief of Mariveles tribe, Bataan Province. See Plate IV, figs. 3 and 4. (Photograph by Worcester.)

PLATE IX. AUSTRALOID NEGRITOS.

FIGS. 1 and 2. Side and front views of Negrito man of Capiz Province, of nearly or quite full blood. (Photograph by Miller.)

3 and 4. Side view of chief of Mariveles tribe, of Bataan Province. See Plate IV, figs. 3 and 4. (Photograph by Worcester.)

5 and 6. Front and side view of full-blood Negrito woman of Zambales Province. (Photograph by Diamond.)

7 and 8. Front and side views of young Batak woman (type 8) of Tinabog, Palawan Island. Note the head ornaments and the method of carrying cigar thrust in the head dress. (Photograph by Worcester.)

PLATE X. TRUE NEGRITO EARS. AUSTRALOID?

FIGS. 1 and 2. A Negrito man of Cagayan Province. This man had the curly hair of his race, but managed through frequent combings to straighten it out to its present condition. He also used some special kinds of native oils to attain this purpose. Note the expression given to the countenance by the unusual condition of the hair. (Photograph by Martin.)

3 and 4. Front and side views of Negrito boy of Cagayan Province. (Photograph by Martin.)

5 and 6. Front and profile views of full-blood Negrito man of Zambales Province showing beard on chin.

7 and 8. Front and side views of Negrito man of Zambales Province.

PLATE XI. MODIFIED TRUE NEGRITO EARS.

FIGS. 1 and 2. Front and side views of Negrito man of Zambales Province, of pure blood. (Photograph by Diamond.)

3 and 4. Front and side views of Negrito man of mixed blood of Zambales Province. (Photograph by Diamond.)

5 and 6. Front and side views of Negrito man of Zambales Province showing hair on chin. This man has lost an eye. (Photograph by Diamond.)

7. Front view of head of Negrito man of Zambales Province.

8. Side view of head of Negrito man of Zambales Province.

PLATE XII. COMBINATIONS OF TYPES.

FIG. 1. A bright, native school teacher of Santo Domingo de Basco, Batanes Islands. Not a Negrito. Typical Iberian ears. (Photograph by Martin.)
2. Negrito woman of mixed type, Zambales Province. Primitive.
3 and 4. Man of Mount Isarog, Ambos Camarines Province. Shows his Negrito blood. (Photograph by Miller.)
5 and 6. Front and side views of Negrito man of Zambales Province, of pure blood.
7 and 8. Front and side views of Negrito of Zambales Province, known to his fellows as the "Captain-General" of the mountains.

PLATE XIII. MARIVELES NEGRITOS.

FIG. 1. Full length view of typical Negrito man of Bataan Province. (Photograph by Worcester.)
2. Negrito of Bataan Province, the tallest Negrito I have ever seen. It will be noted that his remarkable height is due to extraordinarily long legs. (Photograph by Worcester.)
3. Full length view of typical Negrito man of Bataan Province. (Photograph by Worcester.)
4. Chief of the Mariveles tribe, Negrito of Bataan Province. See Plate IV, figs. 3 and 4. (Photograph by Worcester.)
5. Typical Negrito man of Bataan Province. (Photograph by Worcester.)
6. Full-grown Negrito man of Bataan Province. See Plate I, figs. 1 and 2. (Photograph by Worcester.)

PLATE XIV. LONG-AND SHORT-LEGGED NEGRITOS.

FIG. 1. Negrito man in front of his hut near Batobalani, Ambos Camarines Province. (Photograph by Miller.)
2. A young Negrito of Bataan Province, at his prime with bow and arrow, and boar bristle ornaments on his legs. (Photograph by Worcester.)
3 and 4. Batak man (Type 3), his wife (Type 6) and child, Tinitian, Palawan Island. (Photograph by Worcester.)
5. A Negrito of Zambales Province, of mixed blood.
6. A Negrito of Zambales Province, of full blood. Note relative size of figs. 5 and 6.

PLATE XV. LONG-AND SHORT-LEGGED NEGRITOS.

FIG. 1. A Negrito, standing, of Cagayan Province. (Photograph by Martin.)
2. Typical full-blood Negrito man, of Zambales Province. (Photograph by Diamond.)
3. A Negrito man of Isabela Province, at his prime. (Photograph by Worcester.)
4. A Negrito sub-chief of Isabela Province. (Photograph by Worcester.)
5. A Negrito boy of Cagayan Province. (Photograph by Martin.)

PLATE XVI. NEGRITOS WITH INTERMEDIATE LEG-LENGTH.

FIG. 1. Negrito man near Batobalani, Ambos Camarines Province. (Photograph by Miller.)
2. A young Batak man (Type 2) of Tinabog, Palawan Island. (Photograph by Worcester.)

FIG. 3. Negrito man of Cagayan Province. See Plate X, figs. 1 and 2. (Photograph by Martin.)

4. A young Batak man (Type 1), of Tinabog, Palawan Island. Note the typical hair-cut. (Photograph by Worcester.)

5. A Negrito man near Batobalani, Ambos Camarines Province. (Photograph by Miller.)

PLATE XVII. GROUPS OF ZAMBALES NEGRITOS.

FIG. 1. A group of five Negrito men of Zambales Province, of mixed blood; indeed, the man at the left seems to have no Negrito blood at all and the man at the right has very little. (Photograph by Diamond.)

2. A group of Negrito men, of Zambales Province, mostly old and infirm types. Note rattan tied around their legs below the knees as a cure for rheumatism.

FIG. 1.

FIG. 2.

FIG. 3.

PLATE A


FIG. 1.


FIG. 2.

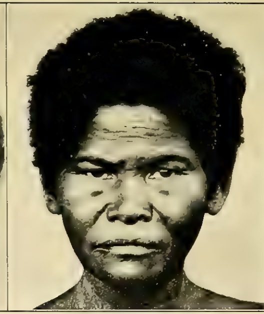


FIG. 3.


FIG. 4


FIG. 5.

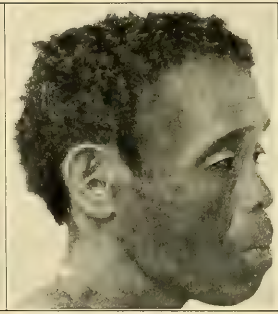


FIG. 6.


FIG. 7.


FIG. 8.

PLATE I.

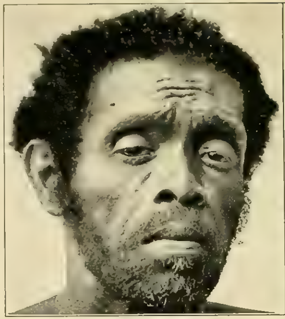


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

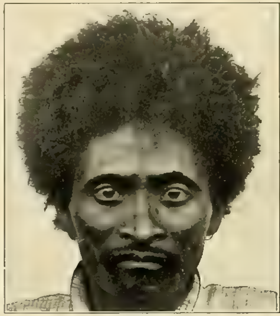


FIG. 5.

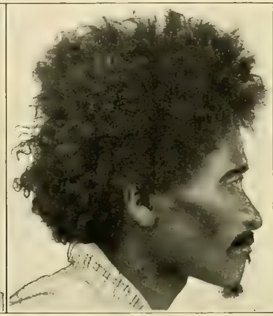


FIG. 6.

FIG. 7.

FIG. 8.

PLATE II

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

PLATE III.


FIG. 1.


FIG. 2.

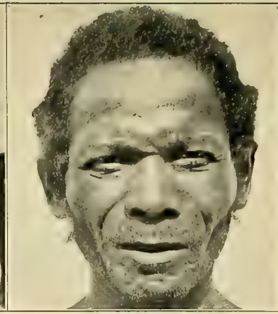
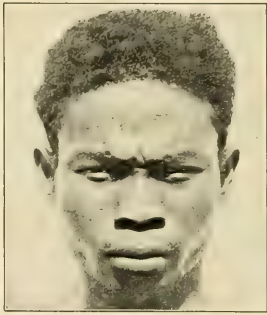


FIG. 3.


FIG. 4.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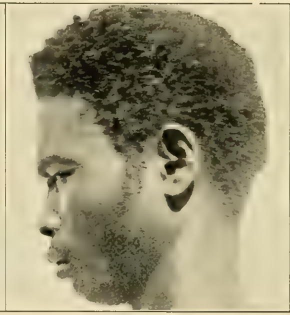
FIG. 6.


FIG. 7.


FIG. 8.

PLATE IV.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

PLATE V.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

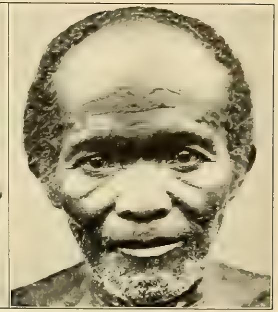

FIG. 8.

PLATE VI.

FIG. 1.

FIG. 2.

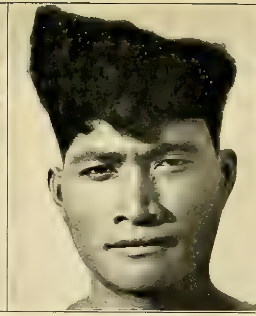

FIG. 3.

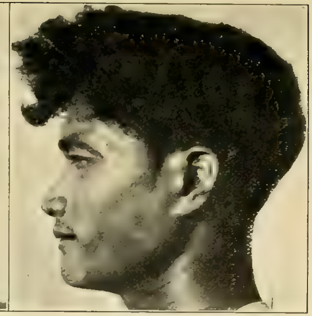

FIG. 4.

FIG. 5.

FIG. 6.

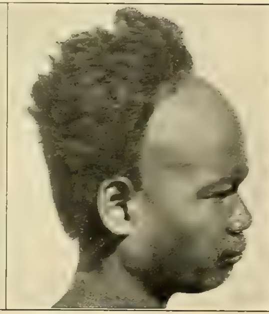

FIG. 7.

FIG. 8.

PLATE VII.

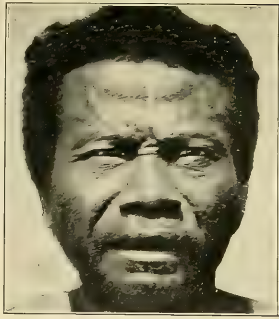

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

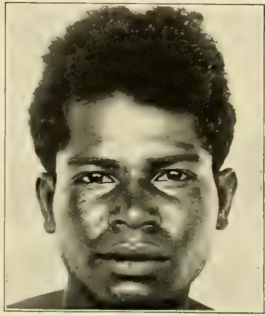

FIG. 5.

FIG. 6.

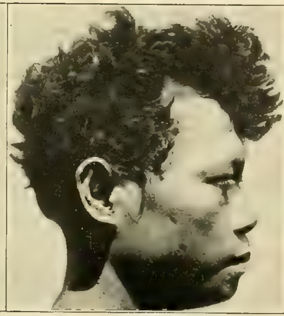

FIG. 7.

FIG. 8.

PLATE VIII.

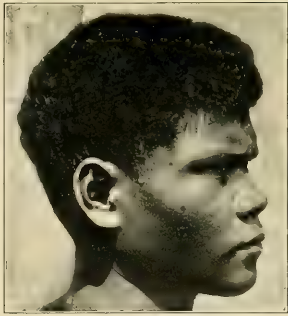

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

PLATE IX.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

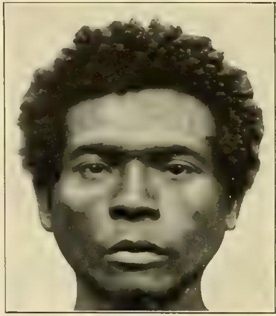

FIG. 5.

FIG. 6.

FIG. 7.

FIG. 8.

PLATE X.

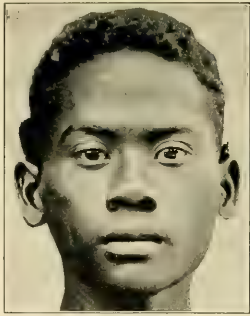

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

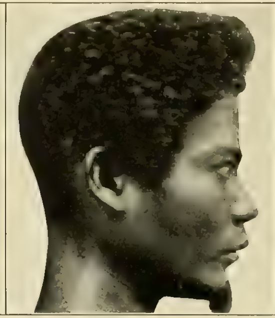

FIG. 6.

FIG. 7.

FIG. 8.

PLATE XI.

[PHIL. JOURN. SCI., VOL. VI, NO. 2.

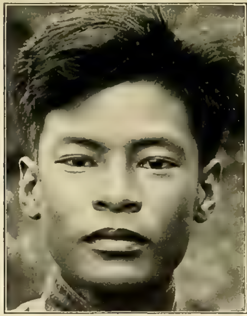
FIG. 1.


FIG. 2.


FIG. 3.


FIG. 4.


FIG. 5.


FIG. 6.

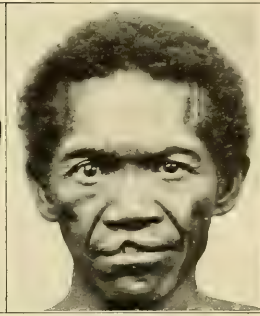
FIG. 7.


FIG. 8.

PLATE XII

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

PLATE XIII.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.

PLATE XIV.

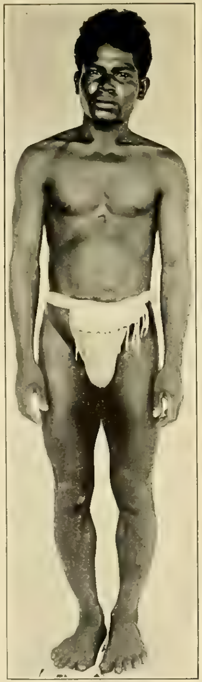

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

PLATE XV.

FIG. 1.

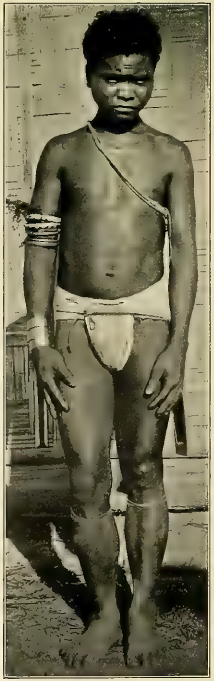

FIG. 2.

FIG. 3.

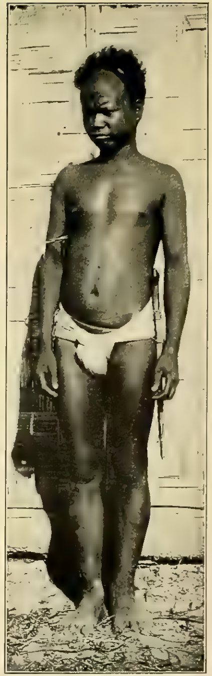

FIG. 4.

FIG. 5.

PLATE XVI.

FIG. 1.

FIG. 2.

PLATE XVII.

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D. GENERAL BIOLOGY, ETHNOLOGY
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VOL. VI JUNE, 1911 No. 3

## THE BAGOBOS OF DAVAO GULF.

By FAY COOPER COLE.

*(From the Field Museum, Chicago, and the Bureau of Science, Manila.)*

This article gives in brief some of the results of an extended investigation now being carried on by the Field Museum of Natural History among the non-Christian tribes of Mindanao. The funds for this work are provided through the generosity of Mr. Robert F. Cummings, of Chicago. The detailed study of this people will appear later under the title The Tribes of Davao Gulf.

Mount Apo, the highest peak in the Philippines, is situated a few kilometers from the Gulf of Davao in southern Mindanao. The non-Christian people known as Bagobos live on its lower slopes, which in some places reach to the sea, from Daliao on the east to Digos on the west. On the eastern border of their territory they merge imperceptibly into the Atas and Guiangas, while to the west the influence of the Bilaans is strong both in material culture and in blood.

In color the Bagobos are a light reddish-brown with a slight olive tinge which is more pronounced in the women than in the men. Their hair is brown-black and varies from slightly wavy to closely curled; face hairs are generally removed, yet some men have rather full beards.

The average height of the men is about 158 centimeters and of the women 147 centimeters; the body is uniformly well developed, but never stocky. The forehead is high and full; the crown and back of the head

strongly arched; and the distance from the tragus to the vertex is somewhat greater than in most Philippine tribes.

The face is high and moderately broad, with cheek bones seldom prominent. The eyes are dark or black-brown and are set far apart, while the eyeslits are oblique. The root of the nose is low; the ridge broad and inclined to be concave, although straight noses are not uncommon. The lips are broad and protruding; the chin round and well formed.

Both men and women pierce and stretch the lobes of the ears so as to admit enormous ear-plugs. Those worn by the women are usually of wood, inlaid with silver or brass, and are connected by a beaded band which passes under the chin. Wooden plugs are also much used by the men, but the most highly prized ornaments are large ivory ear-plugs, made like enormous collar buttons. Both men and women file and blacken the teeth.

The Bagobos are without doubt the most handsomely dressed wild people in the Philippines. The men confine their long hair with head kerchiefs, the edges of which are decorated with beads and tassels. A close-fitting undershirt is often worn, and above this is an elaborately beaded or embroidered coat which opens in front and seldom reaches as low as the waist. The hemp-cloth trousers scarcely reach the knee, and the bottom of each leg is decorated with a beaded or embroidered band. Two belts are worn, one to hold the trousers, the other to support the fighting or working knives which the man always carries. In lieu of pockets, each man has on his back an elaborately beaded hemp-cloth bag which is bordered with tassels, and bells of native casting. Both men and women have many strands of beads encircling the neck and often falling free on the chest. Shell bracelets are also commonly worn.

The dress of the woman is not less artistic than that of the man. Her jacket is close fitting around the neck and reaches to the skirt, so that no portion of the upper part of the body is exposed. These jackets are embroidered over the shoulders and arms, and at the neck and waist; often they have complicated designs in shell disks or beads. The skirt is made like a sack with both ends open, and is held at the waist with a cloth or beaded belt. Many strands of beads encircle the neck, and often a broad bead necklace is worn over one shoulder. A small carrying bag decorated with beads and bells is suspended from a shoulder. The women are fond of loading their arms with ornaments of brass and shell, while anklets and leglets with rattles and bells attached are commonly worn.

According to the historians of the tribe Mount Apo was the first home of the race.[1] The tradition in part is as follows:

When the world first began to be there were one man and one woman and they lived on Mount Apo near the place where the town of Cibolan now is. The

[1] Other tales concerning the origin of this people are current, but the one here given is the most often heard and generally accepted.

name of the man was Toglai and of the woman Toglibon. Many fruits grew on the mountain and the forest was filled with game, so that it was easy for them to procure food. After a while they had many children, both boys and girls, who, when they grew up, married.

One day Toglai and Toglibon told their oldest boy and girl that they should go far away across the ocean, for there was a good place for them. So the two departed and none of the Bagobos saw them again until their descendants—the white people—came back to Davao. The other children remained with their parents and were happy and prosperous until Toglai and Toglibon died and went to the sky, where they became spirits.

Shortly after their death the country suffered a great drought. No rain fell for three years; the rivers became dry, and the plants shriveled and died, so that there was no food in the land. The people said: "Manama [2] is angry and is punishing us, for he has taken away our plants and water; surely we must go to a new place where there is food or we shall die." Two started on the way toward the sunset, carrying with them stones from the Cibolan River, and in a few days reached a good land where there were water and plants, and pigs and deer abounded in great fields of grass. There they settled and in time many children were born to them. Since then they have been called Magindanau because of the stones which they carried with them when they left Cibolan.

Two others went to the southward and when they found a good land they stopped and made their home. On their journey they carried small baskets called *bira-an*, and because of this their children are known as Bira-an.[3] A pair who went to the northward carried small dolls and thus obtained the name Eto.[4]

The tradition accounts for the naming of six other tribes known to the Bagobos, and then coming to themselves it continues:

One pair only remained at Cibolan. They wished very much to go away, but were so weak from hunger and thirst that they could not walk far. One day the man crawled out into the fields once more to see if he could find some one thing alive, and when he reached there he saw a single stalk of *tubbo*—sugar cane—growing lustily. He cut a piece from the side and water began to run out until there was enough for the couple to drink. Because of this they called the place Bagobo and the people have since borne that name.

From the time of the dispersion of the people until about three generations ago the story tellers have little to add. At that time, we learn, the Bagobos had become numerous. Taopan [5] of Cibolan ruled over all their land. Under his leadership they made frequent forays into neighboring districts and returned with many slaves and rich loot. The *datu* [6] was noted as a brave warrior, but in addition to this he was a wise and just ruler, greatly beloved by all his people. When he died more than one thousand of his subjects attended the funeral, which lasted

[2] A name often applied to the greatest of all spirits, Eugpamolak Manobo.

[3] More commonly pronounced Bila-an.

[4] The name applied to the Guiangas and Atas living north and west of Daliao.

[5] P. Juan Doyle, S. J., gives the following genealogy for the Bagobo *datus:* Salingolop, Bato, Boas, Basian, Lumbay, Banga, Maliadi, Taopan, Panguilan, Manip.

[6] The Moro name for chief or ruler. The Bagobo name is *lagiamoda*, but the Moro term is in general use.

ten days. On the last day the house was decked, inside and out, with red and yellow flowers; many valuable gifts were placed beside the corpse and the place was then abandoned.

He was succeeded by his son Pangilan, whose administration, like that of his father, was firm and just. Upon his death he bequeathed the leadership of a united people to his son Manib. The new *datu* did not prove to be a great warrior and his decisions in matters of dispute were not always just, so that bad blood arose between the people of Cibolan and Talun. He was unable to quell the disturbances, and finally open warfare broke out, petty chiefs of other districts throwing off his control and ruling as *datus*. This was the condition which confronted his son Tongkaling when he found himself ruler of Cibolan.

The claims of leadership over all the Bogobos had never been relinquished, but the actual power of the *datu* outside his own district amounted to little. Tongkaling soon established his right to the name of a great warrior, and his people so prospered under his rule that upon the advent of the Americans he was much the most powerful among the several chiefs. Under the administration of Governor Bolton, Tongkaling was officially recognized as the head of the Bagobos, and with this added prestige, he has finally succeeded in gaining recognition from all the chiefs, except those about Santa Cruz, but his actual control over them is still very slight. He has been a consistent friend of the Americans, but has jealously guarded his people against outside influences, so that they are much less affected than those of other districts. For this reason this paper deals principally with Cibolan, but where radical differences occur in other districts they will be noted.

According to the long-established custom when a new ruler was to assume control, Tongkaling gave a great celebration and summoned the people from near and far. On the appointed day more than seven hundred guests had arrived and for six days they feasted, drank, danced, and made merry. On the seventh day the majority of the guests accompanied the *datu* to a great tree in the forest and there witnessed or took part in a human sacrifice.

For this occasion the *datu* had provided a decrepit old Bila-an slave for whom he had paid three *agongs*.[7] The man was fastened with his back to the tree, his hands tied high above his head. When all was ready one of the chief warriors addressed the spirits, asking them to witness that the people followed the old custom, and to let the reign of the new *datu* be one of continued prosperity without defeat in battle. The prayer finished, the *datu* placed his spear just in front of, and below the right armpit, and plunged it with full strength into the body of the slave. As soon as he had withdrawn his weapon the warriors cut

[7] Copper gongs worth about 16 pesos each. One peso is equal to 50 cents United States currency.

the body in two, across the chest, with their fighting knives, and then having loosened the parts from the tree threw them into a shallow grave which had been dug near by. The people returned to the village and continued the merrymaking during the night, after which they returned to their homes and Tongkaling was fully established as ruler.

The people have long been accustomed to obey some powerful headman and, to a certain extent, they become the servants of the new chief; but certain laws handed down by their ancestors are so well established by custom that no one thinks of changing them.

The *datu* is supreme judge in all cases, but he may, if he desires, call in the older men to help him decide the difficult ones. The levying of a fine is the common method of punishment. Should the culprit be unwilling or unable to pay, he is placed in servitude until such time as the debt is considered canceled. Should he refuse to serve, he is killed without further ado. The *datu* appoints a man for this purpose and he usually gets his victim by stealth, either by waylaying him in the road or by driving a spear through him as he sleeps on the floor of his house. When a fine is levied the *datu* retains a portion as pay for his services; if the more drastic punishment follows it serves to emphasize his power and is more valuable to him than the payment. Theft is punished with a fine; murder by death, if the victim is from the same or a friendly town, and the murder unprovoked. Incest[8] must be punished by the death of both parties, otherwise the spirits will cause the sea to rise and cover the land. The crime is uncommon, yet Tongkaling claims to have exacted the death penalty in two cases. In the first, he had the two offenders bound and thrown into the sea; in the second the culprits were fastened to a tree, in the same manner as already described, and two warriors cut the bodies in two with their fighting knives, while all the people stood by and witnessed the punishment. If a wife is unfaithful, her husband may kill both of the guilty parties without fear of punishment, provided that he leaves the spear or knife with which he kills the pair in the body of one of them. A weapon so left is a sign that the killing was because of the fault and the avenger can not be held accountable either to the *datu* or the relatives of the dead man. However, if he withdraws his weapon from the body, the brothers or relatives of the deceased have a right and duty to avenge the death. Cases are known where the husband accepted payment for his wife's affections, but it was considered a sign of weakness or cowardice, and the man lost caste.

Slavery is a recognized institution, and the need of slaves is one of the chief incentives for hostile raids against neighboring tribes. A good

[8] Intercourse between brother and sister, mother and son, father and daughter, between first cousins, between mother-in-law and son-in-law, and father-in-law and daughter-in-law comes under this head.

slave, male or female, is valued at about five *agongs*. If a slave woman bears children to her master she is usually freed at once, or if not then, she is certain to be at his death. Her children are free and legitimate heirs. It is considered a serious crime for a man to have illicit relations with another man's slave and a heavy fine will be levied on the offender. Should children be born from such a union they are treated as slaves.

Polygamy is common, kinship and the lack of funds forming the only restrictions to the number and choice of wives a man may have.

Certain prohibitions exist as to the wearing of the clothing which distinguishes successful warriors and priestesses, but punishment in these cases is meted out by the spirits and not by the *datu*.

Cibolan is not a compact village, but consists of many small dwellings scattered along the mountain sides close to the clearings in which the people raise rice, corn, *camotes*,[9] and hemp. These houses are generally of one room with the floor raised high above the ground. The sides are of flattened bamboo, in which small, rectangular openings or peep holes are cut. The sides of the roof rise to a steep peak which, at the top, overhangs the ends. Entrance to the house is gained by a ladder or notched pole. Stones, sunk in a bed of ashes, form the stove which stands near the door. A raised platform, about one and one-half meters wide, at the far end of the room serves as a bed for part of the family.

In time of danger, or during festivals, the people assemble at the house of the *datu*. This is an immense structure, built on the same general plan as the smaller houses, but capable of holding about two hundred people. Elevated, box-like enclosures are constructed along the sides of the room where the *datu* and some of his daughters or wives keep their belongings, and in which they sleep. The elevated platform at the end of the room is occupied at night by the fighting men, while the balance of the household—men, women, children, and dogs—use the floor. Along the walls are fastened spears, shields, looms, musical instruments, and what not, and in the center of the room hang six large *agongs* which furnish music for the dancers. Near to these are two tall bamboo poles, decorated with stripped leaves. These and numerous other devices and receptacles in other parts of the room are for the spirits who control the lives and happiness of the people.

To describe in detail the numerous spirits known to the Bagobos, or the ceremonies made to secure their good will, would exceed the limits of this paper, but a few must be mentioned in order to give a clearer insight into the lives of the people. Eugpamolak Manobo[10] is the chief of all spirits. It was he who created the world. No ceremony should be made without calling on him and offering him some white food or object of value.

[9] Sweet potatoes.
[10] Also called Manama.

The term *diwata* is applied to a powerful class of spirits who live near to and serve the great spirit. Toglai and Toglibon have already been mentioned as the first man and woman. Since their death they have assumed important places in the spirit world. All marriages and births are caused by them, and they also keep close watch over the lives of men. The *tigyama* are a class of spirits, one of whom watches over each family. When children of two families marry their *tigyama* merge into one, who assumes guardianship of the pair. Taragomi owns all articles of food and is guardian of the fields and crops. A shrine is built for him in the center of the field, and after the rice is gathered a great ceremony is made to thank him for the successful harvest. The *buso* are low, mean spirits who eat dead people and have some power to injure the living. They are sometimes identified with the spirits of the dead. All these and many more are addressed by the priestesses or "doctors."

The "doctor" is known as *mabalian* and is generally a woman past middle life—a woman of influence and a skilled weaver—who has been warned by the spirits to become *mabalian*. It may be that a friendly spirit has imparted a new remedy to her, and to this knowledge she adds all that the older priestesses can teach her of the art of healing the sick, of the duties of a midwife, and the manner of conducting ceremonies and offerings for the higher beings.

The weavers of hemp cloth are under the special patronage of the spirit Baipandi, who taught the women the intricate method of overtying the warp so that portions of the thread do not receive the dye. She also taught the designs which are woven into the fabrics, and the art of embroidery and bead work. Particular spirits are also the patrons of the iron and brass workers.

Two very powerful spirits are still to be mentioned. These are Mandarangan and his wife Darago. They are the guardians of the warriors and can be addressed only by the *magani*. The name *magani* is a term applied to a man when he has killed two or more persons. He is then entitled to wear a peculiar, chocolate-colored head covering with white patterns in it. After his score has reached six he is permitted to wear a blood-red suit and carry a bag of the same color. His dress does not change as the number of his victims increases, but his influence grows with each life put to his credit. A man who kills an unfaithful wife and her admirer may count the two on his score; he may also count those of his townspeople whom he has killed in fair fight, but unprovoked murder will be punished by death. He may go to an unfriendly town and kill without fear of censure from his own people, and the fact that he generally attacks from ambush or at night does not detract from the honor due him for the deed. The *magani* is one of the chiefs in a war party; he is also chosen to inflict the death penalty when it is decreed, and it is usually men of this class who assist in the human sacrifices.

Each year when the constellation *balatik* [11] appears in the sky a human sacrifice should be held in honor of the two patron spirits of the *magani.*[12] This should be done regardless of good or bad times, but any person who has been troubled by evil spirits during the year, or any family in which a death has occurred, may have a part in the sacrifice by making a small payment to the *datu* who is furnishing the victim.

On the appointed day people gather from near and far to witness the ceremony. The slave is tied, as before described, and the *datu* directs the spear so that it will enter the body just below the right arm. All persons who have purchased a part in the sacrifice may take hold of the spear and at a given signal it is thrust through the body of the victim. the *magani* who is willing to pay the highest price for the honor then cuts the body in two with his fighting knife, after which it is buried.

At the sacrifice which took place at Talum in December, 1907, parts of the body were presented to certain guests and were carried away. However, this does not seem to be the general custom. No part of the corpse is eaten or tasted at this time, but warriors sometimes eat portions of the livers of brave enemies, thinking thus to gain in valor.

A short time after this offering a great ceremony known as *ginem* is held.[13] During its progress two festooned poles are raised by the *magani,* who afterwards gather around them and one by one confess to the spirits, Mandarangan and Darago, all their warlike deeds; the number of lives they have taken; the slaves captured; and in short all that entitles them to be known as *magani.*

Offerings are provided for other spirits in another part of the house, but the ceremony is made chiefly to secure the good will of the war deities.

Other ceremonies are held in honor of the patron spirit of the blacksmiths, of the brass workers, and of the weavers. When a field is to be cleared, the first rice planted, and at the time of reaping, the spirits are consulted and offerings are made to them. After all the grain is safely stored a thanksgiving feast, rivaling the *ginem* in importance, is held.

Severe sickness is cured by appealing to unseen beings, and those evilly disposed are frequently appeased by the erection of a small shrine, on which offerings are placed. Daily actions are often determined by omens imparted by the birds, and at the critical periods of life the superior beings are always consulted.

When a birth is expected, the husband summons a *mabalian,* who at once begins to administer certain medicines calculated to cause an easy delivery. She spreads out a mat in the center of the floor and on this

[11] A constellation which appears about the middle of December.

[12] Some of the people insist that the sacrifice is partly in honor of Balakat, the spirit who loves blood.

[13] Datu Anisig of Talum informed the writer that the sacrifice should occur during the first day of the *ginem,* just before the festooned poles are raised in the house.

places many valuable articles of wearing apparel, weapons, and *agongs*. These she offers to the spirits, beseeching them to permit an easy birth, and to give good health to the mother and child. The articles offered at this time may be used by their former owners, but as they now belong to the spirits they can not be disposed of unless others of equal value are substituted.

The *mabalian* cuts the umbilical cord and assists in the removal of the afterbirth, which she places in a bamboo tube, covers with ashes and then hangs to the side of the house, where it remains until it falls of its own accord. The child must be placed at once on a soft piece of bark for "its bones are soft and our hands are hard and will injure it," and water is poured over it. The *mabalian* must then rub a mixture of clay and medicine on its eyes, and on the eyes of all who witnessed the birth, otherwise they would become blind. For her services she receives from five to twenty pesos, according to the wealth of the family and the sex of the child. Twins are accepted without question, but triplets are killed at once by filling their mouths with ashes. "If this is not done the parents will die, for they are like animals."

Marriage among the Bagobos takes place much later than is common among most Philippine tribes, the couple often being eighteen or twenty years of age. As a rule the parents of the boy select the girl and negotiate the match. Going to the house of the girl they casually broach the subject, and if her parents are favorable a certain day is set to discuss the details. This meeting is attended by the friends and relatives of both families, and two headmen or *datus* must also be present to represent the contracting parties. The price the girl should bring varies according to the wealth of the interested parties and the accomplishments of the bride. Whatever the sum paid, the father of the girl must make a return present equal to one-half the value of the marriage gift "so that he does not sell his daughter like a slave."

Usually marriage does not take place until a year or more after this settlement, and during the interval the boy must serve his father-in-law to be. When the time for the final ceremony arrives the relatives and friends assemble and for two or three days they feast and make merry. A *mabalian* spreads a mat on the floor, places on it many valuable articles and then offers all to the spirits, in order that they may be pleased to give the couple a long and prosperous life together. Finally, she puts a dish of rice on the mat and after offering it to the spirits she places it between the boy and girl as they sit on the floor. The girl takes a handful of the rice and feeds it to the boy, who in turn feeds her, and the ceremony is complete. The couple may then go to their new home, but for several years the girl's family will exact a certain amount of service from the groom.

When a person is critically ill, he is removed from his own house to another in order that he may be under the care of the good spirits

residing there. Should it become evident that he will die he is taken back to his own place, otherwise his family must reimburse the owner of the house in which the death occurs for bringing evil or unfriendly spirits into their dwelling.

Unless the deceased has been a person of considerable importance the body is kept only until a coffin can be hollowed out of a split log. He is then dressed in good clothes and placed in the coffin together with his weapons or other prized articles; the top of the log is fitted over the lower half and he is buried beneath the house. From that time until a human sacrifice has been made the family is required to wear old clothes, to eat poor food, and to abstain from dancing and other pastimes.

It is possible to remove the taboo by making a special sacrifice, but more commonly all the families in which deaths have occurred will buy a part in the yearly offering, made after the appearance of the constellation *balatik*.

# ILLUSTRATIONS.

PLATE I.

House of Bagobo *datu.*

PLATE II.

FIGS. 1 and 2. A Bagobo man.

PLATE III.

FIG. 1. A Bagobo weaver with loom.
2. A Bagobo weaver overtying warp threads.

PLATE IV.

FIG. 1. A group of Bagobo women.
2. Bagobos harvesting rice.

PLATE I.

FIG 1.

FIG. 2.

PLATE II.

FIG. 1.

FIG. 2.

PLATE III.

FIG. 1.

FIG. 2.

PLATE IV.

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# THE SKELETON IN THE FLYING LEMURS, GALEOPTERIDÆ.

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(*Washington, D. C.*)

## INTRODUCTION.

Osteological material for the present contribution has been furnished by Professor J. B. Steere of Ann Arbor, Michigan, and by Mr. Richard C. McGregor, of the Bureau of Science, Manila, P. I. What this material consists of, together with letters and other notes accompanying it, will be set forth further on in the present introduction.

A number of comparative anatomists have touched upon the morphology of probably several of the species of the flying lemurs, but until the present time it appears that no fully illustrated and detailed account of the osteology of these remarkable animals has been published.

Owen,[1] in giving the characters of the skeleton of the Insectivora, briefly refers to the skull and some few of the limb bones of *Galeopithecus,* but in the case of the skull, unfortunately, he does not make it sufficiently clear as to whether the description does not likewise apply to *Pteropus.* Thus he says:

> This [that is the skull] in *Pteropus* and *Galeopithecus* manifests the lissencephalous affinity by the squamosal being perforated by a venous canal behind the root of the zygoma, by the suspension of the malar, in the zygoma, by the distinct petrotympanic, by the vertical occiput, small cranial cavity, and blended orbital and temporal fossæ. The orbit is partly defined behind by long and slender processes of the frontal, which is perforated by a superciliary foramen. The parietals usually coalesce at the sagittal suture, but rarely develop a crest.

The paragraph continues in confused and inaccurate generalities to the end and closes with the statement that "in *Galeopithecus* the coronoid is small." Little more than this is added to his description of the skeleton, in fact only that

> In the Colugo (*Galeopithecus*) the ulna terminates in a point at the lower

[1] Anatomy of Vertebrates (1866), 2, 387, 388.

fourth of the radius;[2] all the five digits of the hand, like those of the foot, have claws supported on deep compressed ungual phalanges.[3]

Owen gives a figure of the skull of *Cynocephalus,* seen upon superior view, which is quite different from any of the specimens at hand. It is far more massive, broader for its length, and appears to be inaccurate in other particulars, although there exists considerable individual variation in skulls of this animal, when series of them are compared.[4]

The skeleton is not touched upon by Mivart,[5] although he makes record of the interesting fact that "in many tortoises both the knee and the elbow are rather twined outwards, than the former forwards and the latter backwards, as is also the case in the Flying Lemur (*Galeopithecus*) amongst beasts."

This anatomist placed *Cynocephalus* in the order Insectivora, and the Lemuridæ among the Primates, a classification which now few would agree to, in so far as the latter are concerned.

Five years prior to this Huxley[6] presents a much fuller account of the structure of the species here being considered and practically agrees with Mivart in the matter of their classification.

He sees "no reason for dissenting from Professor Peter's view that *Galeopithecus* belongs neither to the Primates, nor to the Cheiroptera, but that it is an aberrant Insectivore." In fact, as he says on the previous page of the same work, it is "the most aberrant form of the *Insectivora.*"

When studying the skeleton of any animal among the Vertebrata, it is always interesting, and even important, to know something of that animal's habits, and no anatomist appreciated this fact better than Huxley.

We are not surprised then to find, in the work just cited, references to the "arboreal and frugivorous habit" of *Cynocephalus,* and to its "very long and slender limbs." Also that these limbs "are connected with one another, with the sides of the neck and body, and with the tail, by a great fold of the integument, which is called *patagium;* and, unlike the web of the Bat's wing, is hairy on both sides, and extends between the digits of the pes. By the help of this great parachute-like expansion, the *Galeopithecus* is enabled to make floating leaps,

[2] Authors do not agree with respect to the character of the articulation of the ulna with the radius, some stating that the two bones are ankylosed, and others that they are not. Huxley claimed that they are. It is to be noted here that Owen and others employed the name *Galeopithecus volans* for the flying lemur, and where quotations are made, as in the above instance, from those authors, that name will be used. For *Galeopithecus volans* we now write *Cynocephalus volans,* and the latter will be used in this paper, except in quotations. The Malayan genus is *Galeopterus.* See Miller, *Proc. Biol. Soc. Washington* (1906), **19**, 41; Thomas, *Ann. & Mag. Nat. Hist.* (1908), VIII, **1**, 252–255.

[3] *Op. cit.,* 393.

[4] *Op. cit.,* 388.

[5] Lessons in Elementary Anatomy (1877), 10.

[6] The Anatomy of Vertebrated Animals (1872), 383.

from tree to tree, through great distances. When at rest, the *Galeopitheci* suspend themselves by their fore- and hind-feet, the body and the head hanging downward; a position which is sometimes assumed by the Marmosets among the *Primates*."

Selecting from this account only such parts as refer to the skeleton, we note that Huxley observed that in *Cynocephalus* "the fore-limbs are slightly larger than the hind-limbs" and further that "the pollex and the hallux are short, and capable of considerable movement in adduction and abduction, but they are not opposable; and their claws are like those of the other digits.

"The occipital foramen is in the posterior face of the skull. The orbit is nearly, but not quite, encircled by bone. The lachrymal foramen is in the orbit. The bony roof of the palate is wide and its posterior margin is thickened. There is a strong curved post-glenoidal process of the squamosal, which unites with the mastoid, beneath the auditory meatus, and restricts the movement of the mandible to the vertical plane. A longitudinal section of the skull shows a large olfactory chamber projecting beyond that for the cerebral lobes, and two longitudinal ridges, upon the inner face of the latter, prove that these lobes must have possessed corresponding sulci. The tentorial plane is nearly vertical and the floccular fossæ are very deep." All these points are characteristic and correctly stated. "The ulna" he adds, "is very slender inferiorly, where it becomes anchylosed to the distal end of the radius, [?] which bears the carpus. When the ilia are horizontal, the acetabula look a little upward and backward as well as outward. The fibula is complete. As in the Sloths and most Primates, the navicular and cuboid readily rotate upon the astragulus and calcaneum so that the *planta pedis* is habitually turned inward." [7]

In giving the dental formula, Huxley also refers to the peculiar pectination of the lower, single-fanged, incisor teeth, but these structures will be touched upon later on.

Passing to the work of another writer who has investigated the anatomy of the family Galeopteridæ we find that Flower points out a number of the characters of the skeleton in these "aberrant Insectivores," [8] now being examined. Briefly, he says:

The characters of the family are those of the suborder *Dermoptera*, to which may be added that the orbit is nearly surrounded by bone, the zygomatic arches are well developed, the tympanics form bullæ osseæ, the ulna is distally united with the radius, the tibia and fibula are distinct, the pubic symphysis is long.

Then follow descriptions of other parts of structure of these animals. Flower, it is observed, agrees with Huxley with respect to the ankylosis of the bones of the forearm, but that is one of the points that the present paper will settle.

From another work [9] by the same author we learn that in *Cynocephalus* "each vertebra bears at its hinder end a pair of hypopophysial tubercles;" that the number of trunk vertebræ is 21 (15 thoracic and 6 lumbar); that the tail is

[7] The Anatomy of Vertebrated Animals (1872), 382, 383.

[8] Osteology of the Mammalia in Encyclopedia Britannica, 9th ed., 15, 401.

[9] Osteology of the Mammalia, 39.

long; that the number of vertebræ in the spinal column apparently varies for the species thus:

| | Cervical. | Thoracic. | Lumbar. | Sacral. | Caudal. |
|---|---|---|---|---|---|
| G. volans | 7 | 13 | 5 | 5 | 15 |
| | 7 | 13 | 6 | 5 | 14+ |
| | 7 | 14 | 8 | 4 | 17 |
| G. philippinensis | 7 | 14 | 6 | 4 | 17+ |

That the "cranium much resembles that of the *Lemurina*, having a considerable and vaulted cerebral cavity, large orbits, nearly vertical occipital plane, large olfactory fossæ, a well-developed zygomatic arch sending up a postorbital process to meet a corresponding one from the frontal so as either partially or completely to encircle the orbit behind, and tympanics ankylosed with the other cranial bones, dilated into a bulla, and produced externally into a tubular auditory meatus. The face is generally elongated, and narrow anteriorly, but in *Galeopithecus* it is broad and depressed."[10] That the coracoid of the scapula "is greatly developed and bifurcated"; that "the radius and ulna are fused together distally"; "the symphysis of the pelvis, as already stated above, is long"; and, finally, that "the fibula and tibia are complete and remain distinct" throughout the life of the individual.

About a year ago, Mr. Richard C. McGregor, of the Bureau of Science, Manila, kindly forwarded to me for description two adult specimens of *Cynocephalus*, probably *C. philippinensis* (Waterhouse).

Mr. McGregor wrote as follows:

We have on hand two skeletons of *Galeopithecus*, both of which are being sent to you by mail. These were collected near Guindulman, Bohol, where the species is fairly common. A considerable number are killed by the natives, but I did not learn that the fur was used by them. In Cebu there were between 20 and 30 skins of this species for sale in a store; they came from Bohol, of course, as the species is unknown in Cebu. It is found also in Mindanao, Samar, and Basilan.

This animal seems to be strictly arboreal and to feed exclusively on the leaves of trees. It is an animal difficult to see, as whenever it suspects danger it remains perfectly quiet and hugs a branch. Its colors are quite protective. When moving in a tree it is very cautious and seems to glide rather than to move like a squirrel or other small mammal; in fact, its movements impressed me as being very snake-like. The native name is "Ca-guán."

The color of the pelage, even of specimens from one locality, varies greatly, running from seal brown to light gray and from unspotted to thickly spotted with gray.

Padre Elera, in Fauna de Filipinas (1895), 1, 16, lists five species: *Galeopithecus volans* (Shaw), *G. rufus* Geoff. & Cuv., *G. variegatus* Geoff. & Cuv., *G. marmoratus* Temm., and *G. philippinensis* Waterh. as being found in the Philippines, but I doubt if so many species should be credited to these Islands.

[10] In the paragraph just quoted Flower intended to cover not only *Cynocephalus*, but likewise *Tupaia*, *Macroscelides*, and *Rhynchocyon*.—R. W. S.

You may make such use as you wish of the specimens sent, and return them to the Bureau of Science at your convenience.

During the summer of 1908 I communicated with Professor J. B. Steere, of Ann Arbor, Michigan, whose work as a naturalist in the Philippines many years ago is well known. In his courteous reply Professor Steere wrote me that he had collected the skeleton of a specimen of *Galeopithecus* (adult), which he had preserved in the rough; he also had the young, consisting of two fœtuses in spirits. He later on donated the skeleton for my use, but was unable to find the preserved specimens of the young which would have been very valuable additions to my material. The letter he wrote me was interesting, but I have been unable to put my hand on it for some time past, and so recently wrote him again for data, but upon this occasion no reply has been received. In any event I remember Professor Steere wrote me that he collected the skeleton about twenty years ago (1887–88?), but upon which island he had forgotten, and he had no other data, and there was no label on the specimen, so the sex of the individual is likewise unknown. It has been carefully cleaned by me for description in the present connection. Without doubt it was a larger form than the ones from which Mr. McGregor obtained his skeletons, and it leads me to believe that the Steere specimen belonged to a different species. Mr. McGregor in his letter, given above, does not specifically diagnose the two specimens he sent, so that there is some doubt as to whether I really have the skeleton of a true "*G. philippinensis*" at hand, although the material admits of obtaining the characters of the skeleton at least in so far as the genus is concerned.

The McGregor specimens show numerous shot holes in the skulls, and these have given rise to considerable mutilation. This is not the case with the larger skeleton from Steere. It is possible that the examples from McGregor may not be fully adult, a suspicion which is borne out by an examination of the long bones where the epiphysial sutures do not, as yet, seem to have entirely disappeared. Still there are differences to be observed; and while the two McGregor specimens seem to be representatives of the same species, exhibiting only certain individual variations in the skull upon comparison, the skull of the one from Steere, which is fully adult, although possessing the same general characters, has the superficial appearance of having belonged to some other species of the genus.

The "hyoidean apparatus" is missing in the case of all three of these skeletons; all the skeletal ungual joints of manus and pes, so peculiar in their morphology, have probably been retained upon the skins in the case of the specimens from the Bureau of Science, while they are present upon the toes of the skeleton from Steere, and consequently their general characters can be given here.

## OSTEOLOGY OF THE FLYING LEMURS.

### THE SKULL.

As has already been pointed out in the Introduction, there exists considerable variation in the three skulls at hand for examination, which may be due to age, sex, individual variation, or to the skulls having belonged to different species, or to all of these factors more or less combined. Some differences are to be observed even in the case of the two skulls from the Bureau of Science, skulls which, presumably, are from representatives of the same species. The skull from the skeleton collected by Steere evidently belonged to a very old animal, the bones being hard and smooth, with all sutural traces entirely obliterated. Moreover, it is of a clear ocher color and the teeth are considerably worn down. The other two skulls present every evidence of having belonged to much younger individuals; they are quite white; the dental cusps are sharp, and some of the cranial sutures are still traceable.

In so far as size is concerned some of the apparent differences can be demonstrated by measurement, for which purpose the metric system is employed and the results set forth in the following table:

*Measurements of the cranium of Cynocephalus.*

| Specimens. | Extreme length on median line from occipital crest to anterior end of nasal. | Greatest width; intermalar diameter. | Interapical distance between postorbital process of frontal and malar. | Greatest diameter of an orbital periphery. | Greatest transverse diameter at base of occipital area. | Median diameter from foramen magnum to anterior apex of premaxillary spine. |
|---|---|---|---|---|---|---|
| | *mm.* | *mm.* | *mm.* | *mm.* | *mm.* | *mm.* |
| Professor Steere No. 1 | 66 | 43 | 10 | 17 | 31 | 61 |
| Bureau of Science No. 2 | 63 | 42 | 11 | 17 | 27 | 61 |
| Bureau of Science No. 3 | 64 | 45 | 5 | 17 | 30 | 61 |

In some instances, where convenient, in the following description of the skeleton of *Cynocephalus,* the numbers 1, 2, and 3, given to the specimens in the above table may be employed to designate the particular skeleton referred to. This will consist in placing the number in parentheses after any statement made or character described.

In form, after the removal of the mandible, the skull is broad, somewhat compressed from above, downward, and elongate in the antero-posterior direction. When viewed from above it will be observed that the facial portion, anterior to the orbits, contributes very considerably to the marked general breadth of the skull. Its surface is quite smooth, being broadly convex from side to side, and rounded off anteriorly, thus

causing the superior mandibular arch in front to be likewise broadly curved. (Plate II, figure 3.) In some skulls a smooth, low, longitudinal elevation bounds the nasals upon either side, all to a few millimeters in front (1, 3), but this character is not invariably present (2), while in other skulls, the sockets of the canines, and to a lesser degree, the first one or two molars, are indicated on the sides of the maxillaries by smooth, vertical elevations (3), absent in others.

Posteriorly we find the smooth character of the facial portion carried backward to include the frontal region between the orbits, and the narrow parietal space as far back as the occipital crest. This median parietal space lies between the temporal ridges (the latter are always strongly marked), and is broadest where it passes into the frontal area, gradually contracting as we pass backward, to expand slightly again as it arrives at the occipital crest. Its area is determined by the temporal ridge bounding the temporal fossa upon either side. (Plate II, figure 3.)

Anteriorly we see the floors of the orbits, and upon either side, the arch of the zygoma, while posteriorly the broad, concaved piers of the zygomatic arches look directly upward. Between these is the rather ample, semiglobular cranium or brain-case, either side of which, within the temporal fossa, may exhibit considerable muscular rugosity (1); or it may be comparatively smooth (2, 3). Among the few distinctive characters upon this aspect of the skull are the very prominent post-orbital processes of the frontals. They are more or less raised above the interorbital frontal area and jut out from it upon either side. As the periphery of an orbit is nearly circular in outline each contributes to this circularity at its supero-posterior arc. In some skulls the decurved free extremity of the process is produced backward and downward farther than it is in others, thus more nearly completing the bony circlet of the orbit, especially where the postorbital process of the malar is similarly produced, as it is in some skulls (3).

The opening for the supraorbital nerve may be either a "notch" or a foramen and, in any case, occurs far forward upon the orbital rim. It is more in evidence in some skulls (1) than in others, and in one of the specimens here being examined it is a notch on the left side and a foramen on the right (1), while in the other two skulls it is a less conspicuous foramen on both sides. The infraorbital foramen is usually very minute in all skulls and can be distinctly seen only upon lateral view. (Plate I, figure 2.)

Upon regarding the skull from in front there is to be observed the rather large, circular opening of the anterior nares, through which may be seen the vomer and the scrolled ethmoturbinals, two in number, on either side, with the smaller one beneath. The periphery of the anterior narial orifice may (1), or may not (2, 3), be completed in bone. Owen, in his figures of the skull of *Cynocephalus,* has it so completed by the

otherwise intervened free angles of the maxillaries coössifying with the anterior apex of the vomer.[11]

Passing to the posterior view of the skull we find the entire occipital area to be in the vertical plane, the longitudinal axis of the skull being perpendicular to it. The line of the very definitely marked occipital crest is semicircular in outline and there is a strong, median, vertical crest, that passes from the middle point of the occipital crest to the supero-middle point on the periphery of the foramen magnum. The base line of the occipital area is perpendicular to this median crest, while the condyles project slightly below it. These latter are large, semi-ellipsoidal in form, inclined toward each other inferiorly, with their flat sides facing each other and the median plane. They project posteriorly considerably beyond the large and subcircular foramen magnum. The exoccipitals are massive projections with their flat bases in the horizontal plane. (Plate I, figure 1.) In some specimens each of these bases is marked with a deep groove, passing forward and inward toward the median plane (2, 3). A more or less median "occipital prominence" exists above the foramen magnum on the posterior aspect of the skull and is better marked in some specimens than in others.

Chief among the points of interest on the lateral aspect of the skull is the capacious orbit, which is posteriorly incompleted by bone (Plate I, figure 2), and with the plane of its periphery directed outward, forward, and upward. The orbital wall within is entirely completed in bone anteriorly, including the floor below, while posteriorly it is equally lacking in this respect, the whole space in this locality merging with the temporal fossa in its rear. The postorbital process of the malar occupies a mid-point on the strong and twisted zygoma. The posterior root of the latter is broad and starts from an extensive base line on the side of the cranium.

Within the orbit the foramen rotundum and foramen ovale are distinct and occupy their usual sites. The lacrymal foramen is well marked in some skulls (2), minute in others (1), while the other foraminal openings for nerves, are of remarkably small caliber. Elliptical in outline with its major axis vertical, the osseous meatus auditorius externus is likewise small as compared with the size of the cranium. It is found in the deep recess between the posterior root of the zygoma and the exoccipital of the same side.

The basis cranii (Plate I, figure 1) is especially remarkable for the fact that a large share of it lies in the same horizontal plane (see figure 2 of Plate I), which is rather unusual in mammalian skulls. Nearly one-

[11] Anatomy of Vertebrates (1866), 2, 388, fig. 253 and 3, 312, fig. 247. Both of these figures are very different representations of the basal view of the skull of *Cynocephalus*. They are altogether too wide for their length and they are quite crude in the matter of delineation.

half of the inferior portion of the occipital condyles constitutes the sole part of the skull that falls below this plane, the roof of the mouth being only slightly above it. This latter area is laterally bounded by the teeth, but has a free premaxillary margin in front. Its outline is a broad U with its convexity forward. All sutures among the bones, maxillaries, premaxillaries, and palatines have been entirely absorbed, without leaving the slightest trace of their original lines of articulation. The surface is extremely smooth, being slightly concave from before, backward, and rather more so from side to side. The palatine foramina are minute and are situated far back, one on either side, close to the margin of the posterior nares, and even posterior to the anterior peripheries of the same, indicating that the palatal bones contribute but a small share to the bony roof of the mouth. This latter, anteriorly, is deficient in bone, there being a median, circular vacuity found there between the premaxillaries.

Jutting into this anterior palatine fossa, in the middle line from behind, is a sharp, free spine; this is the anterior apex of the vomer. (Plate I, figure 1.) In some skulls (2, 3) this free anterior end of the vomer is in contact, or may unite, with the produced median extremities of the premaxillaries, and thus convert the palatine fossa into a pair of anterior palatine foramina, each elliptical in outline with the major axes directed longitudinally. Owen's skull had this formation, but not so the one collected by Steere, wherein the sharp-edged alveolar incisor margin is noncontinuous to the extent of at least 5 millimeters in the median part. Both skulls from the Bureau of Science agree with Owen's figures (cited above) in that the anterior spine of the vomer is produced forward, bifurcates, and each minute bifurcation either meets, or coössifies with, the premaxillary of its own side. This character at once commands attention upon glancing at the basis cranii of the skull. At the hinder boundary of the vault of the buccal cavity we see the posterior narial apertures. Each is rounded in front, with the convexity so directed, the free margins being embellished with a raised osseous rim that is continued backward, on either side, to terminate as the minute inferior fork of the bifurcation of the hamular process of the sphenoid. The posterior nasal spine is rather large with rounded apex. It occurs in the imaginary plane passing through the centers of the second molars. As apertures, the posterior narial ones are considerably compressed in the vertical direction, which is compensated for by their width.

Each zygomatic arch has a broad base anteriorly, being composed, as usual, of the malar and maxillary bones, its base line including rather more than the second premolar and all three molars. Standing well out from the side of the face, this part of each zygomatic arch has its inferior surface directed downward and outward at an angle of about 45° with the median plane (Plate I, figure 1).

Although the teeth are structures not belonging to the osseous system

in the Mammalia, they are so intimately associated with the mandibles in the skull among all higher mammals and have been so extensively employed in the matter of classification, that to entirely ignore them in any general work upon the osteology of an animal belonging to that class would be considered an almost unpardonable oversight. Anatomists have by no means neglected the dental armature of *Cynocephalus* and we meet with accounts of it in a number of works on comparative anatomy. Here, however, reference will be made to only two authorities, Owen and Flower.

Owen and Flower agree on the dental formula of *Cynocephalus* and, as given in their works, it agrees with all three of the specimens at hand. According to Owen [12] the dental formula of the genus is:

$$i\,\frac{2.2}{3.3};\ c\,\frac{1.1}{1.1};\ p\,\frac{2.2}{2.2};\ m\,\frac{3.3}{3.3}=34.$$

Owen also states that—

The two anterior incisors of the upper jaw are separated by a wide interspace. In the Philippine Colugo they are very small, with simple sub-bilobed crowns; but in the common Colugo (*Lemur volans* Linn.; *Galeopithecus Temminckii* Wat.) their crown is an expanded plate with three or four tubercles; the second upper incisor presents the peculiarity of an insertion by two fangs in both species of *Galeopithecus.*[13]

In the lower jaw the crowns of the first two incisors (*i*), present the form of a comb, and are in this respect unique in the class MAMMALIA. Figure 249 [Owen's figure] shows a section of one of these teeth magnified. This singular form of tooth is produced by the deeper extension of the marginal notches on the crown, analogous to those on the edge of the new-formed human incisor, and those of certain shrews, the notches being more numerous as well as deeper.

Each of these broad pectinated teeth is implanted by a single conical fang, and is excavated by a pulp cavity, which divides into as many canals as there are divisions of the crown, one being continued up the center of each to within a short distance of its apical extremity. The medullary canal or branch of the pulp cavity is shown in some of the divisions of the crown, (at *p*). Each division has its proper investment of enamel, (*e*), which substance is continued for a short distance upon the common base.

The deciduous teeth appear not to cut the gum before birth, as they do in the true Bats. In a fœtus *Galeopithecus Temminckii*, with a head one inch and a half in length, I found the calcification of the first incisor just commenced in the closed alveolus, the second incisor and the rest represented by the vascular uncalcified matrices. The upper milk teeth consist of two incisors, a canine and two molars, which latter are displaced and succeeded by the two premolars. The deciduous teeth are six in number in the lower jaw, the incisors being pectinated, but much smaller than their successors. The true molars are developed and in place before the deciduous teeth are shed.

[12] Anatomy of Vertebrates (1866), 3, 311–313.

[13] If we rely upon this diagnosis based upon the teeth, the specimens here being studied are certainly not *C. volans;* but that would not prove them all to be *C. philippinensis*, as there may be other species having the two anterior incisors of the superior mandible like it.—R. W. S.

Flower committed one or two errors in giving the osteological characters of the *Galeopteridæ*[14] and then briefly dismissed the subject of the teeth thus:

*Galeopithecus* ($i\ \frac{2}{3}$, $c\ \frac{1}{1}$, $pm\ \frac{2}{2}$, $m\ \frac{3}{3}$; second upper incisors and canines with two roots), with two species *G. volans* and *G. philippinensis*. The former, the Flying Lemur of Linnæus, distinguished from the latter by the form of the upper incisors, has a total length of nearly 2 feet.

Now in the upper jaw the two widely separated, anterior, incisors are not only "very small," as Owen points out, but they are, also, at least twice pectinated, and sometimes exhibit a faint indication of a third pectination, which may be discovered by the use of a lens (2). The second pair of upper incisors are the largest teeth in the upper jaw, extending downward below the canines, and very considerably below any of the molars. They are each two-fanged, distinctly triangular in form with a very sharp apex, and are compressed. Both their surfaces, as in the case of the canines, are fluted, the markings running from the base to the apex. A canine of the superior mandible has the same form as the second incisor, only it is somewhat shorter, and wider in the antero-posterior direction.

As stated upon a previous page both the molars and premolars of both jaws in the Steere specimen are very much worn and, therefore, do not present the true characters of these teeth. In the upper jaw the premolars are all two-fanged and offer certain definite characters, the second pair closely approaching in their morphology the anterior pair of true molars. A first upper premolar has a rather complicated tubercular crown consisting of two outer, triangular, sharp-pointed cusps arranged antero-posteriorly to each other; their outer surfaces are flat and longitudinally fluted; their inner surfaces are convex and similarly marked. The inner portion of the crown in the first upper premolar exhibits two more very rudimentary cusps; these in the second premolar tend to become three, as in the leading true molar. The outer cusps in all the true molars agree with those of the premolars, being the most reduced in the last molar. Their inner crowns, that is, the buccal aspect of the crowns, develop from three to four small, sharp, trihedral cusps, and these are partly overshadowed by the inwardly directed pair of outer cusps of any particular molar. All the true molars seem to be three fanged, the largest root being internal, with a pair of much smaller ones placed antero-posteriorly side by side externally. In one specimen (3) the crowns look directly upward, in another (2) they face more toward the median plane, which is decidedly the case in the specimen where they are much worn (1). Through this cause, in the latter, the second premolar has come to resemble very much the leading true molar next to it, its outer cusps being only a little sharper and more pronounced.

[14] *Encyc. Brit.*, 9th ed., 15, 401.

Before completing our study of the basis cranii, it will be as well to finish with the teeth, and to this end examine those of the mandible or the lower jaw. For this purpose one of the specimens (2) from the Bureau of Science will be used, as in it the dental armature is unusually perfect. (Plate I, figure 2.) This specimen presents other interesting features, for on the right side there is to be noted the eruption of a second canine tooth immediately external to the canine belonging to the full set. The former is closely pressed against the latter and is nearly of equal size, although only about two-thirds of the crown has made its appearance. A similar eruption is seen in the case of both second premolars. At the outer side of each, but not in contact with them, a minute cusp is making its appearance just within the alveolar margin. This is another second premolar struggling to the surface. The anterior cusp of the first premolar in this jaw closely resembles the canine next in front of it; the crown of the second premolar possesses characters very much like those of the first true molar, but the cusps are a trifle longer and sharper than they are in the latter.

Six perfect incisors are found in this specimen, three in either side of the mandible. The two pairs in front very closely resemble each other, while the last incisor upon either side is quite different. All are single fanged, and in the dried skull easily tumble out of their sockets. In this particular they markedly depart from the molars, which require some little force to extract them with the fingers. Owen, in his above-cited figure of a section of one of the first incisors of the lower jaw, makes seven elongate pectinations on the tooth, while in the four now being considered, there are at least eleven of these structures. The crowns of the two central incisors are somewhat narrower than in the pair to their outer sides, otherwise, as has been remarked, they are similar. The exposed part of the tooth in any case is nearly square in outline. As normally implanted the teeth point almost directly forward; that is, their anterior and posterior surfaces, including the cutting edges, lie almost in the horizontal plane, and, excepting prehension, it is difficult to understand the use for which they can be employed. In young specimens these four incisors are of a glistening, enamel white, while in old age they become stringy and flexible. Each is gently concave on its inner (here upper) aspect, and correspondingly convex on its outer surface or, in reality, its inferior surface. Owing to their pectination, the free distal edges are minutely serrated. The pectinations are of nearly uniform length, the proximal ones being the shortest in any particular tooth. They are subcylindrical in form, extremely delicate in structure, although very strong, and it requires a lens of some power to reveal the fact that the interstices among them are carried down to their bases; distally, they are apparently in close contact, but not fused. No other living mammal possesses such teeth as these.

Passing to one of the third lower incisors a very different tooth is seen. The coronal portion is antero-posteriorly elongated; as naturally implanted, it is directed upward; it is slightly concave on buccal aspect and correspondingly convex on its outer surface; it presents five pectinations which become smaller and smaller from before backward; the fifth pectination is sometimes very rudimentary. This tooth is much thicker than any one of the four thin, front incisors just described. These six incisors are very nearly, or quite, in contact and there is no true diastema among the teeth of either jaw. The very wide interval between the two anterior incisors of the upper jaw can hardly be considered a true diastema.

The last premolar, and the true molars of either side of the mandible, develop from four to five sharp-pointed, trihedral cusps that vary considerably in size and, packed together along the alveolar border, lend to the series a very complicated appearance. The largest cusps are external and median, while the much smaller ones are, as a rule, ranged internally.

With the jaws normally articulated and tightly closed, the abruptly inturned, sharp-pointed, external cusps of the molars and last premolars of the upper jaw lie entirely without the alveolar margin of the lower jaw, and in mastication act as true cutters rather than as grinders. When the mandible is thus normally articulated, and we regard the skull as a whole upon its basal aspect, all these aforesaid cusps are in full view, even their apices, which is a very remarkable arrangement.

Returning to the base of the skull we next observe the far backward extension of the pterygoidal wings of the sphenoid, with the rather deep longitudinal valley that exists between them. These wings turn slightly outward, and at the postero-inferior angle of each there is to be noted the not very large, bifurcated, hamular process already referred to above.

Passing mesially from the posterior end of the vomer from beneath the posterior nasal spine, there is a prominent ridge, or line, running backward almost to the anterior margin of the foramen magnum. This line is most conspicuous and sharpest in its anterior part, and at its posterior ending merges gradually into the general surface on the basi-temporal. Between the backward sloping termination of a pterygoidal wing and the glenoid fossa, upon either side, occurs the foramen ovale, the largest pair of foramina in the basis cranii. Each transmits, on its own side, the third division of the fifth nerve, the small meningeal artery, and the small petrosal nerve.

The glenoid fossæ constitute prominent features on the base of this skull; either one is large (elongo-elliptical in outline, with the major axis perpendicular to the cranial axis), flat, and smooth, the articular surface being in the horizontal plane, and completely overlying the inferior surface of the posterior root of the zygoma. (Plate I, figure 1.) These fossæ are separated mesially by an average distance of 15 millimeters.

Below each glenoid fossa we meet with a prominent postglenoid process. These are vertically compressed, nearly square in outline, smooth on their upper articular surfaces, and roughened upon their lower. Both point directly forward and very slightly downward. Through the aid of the postglenoid process, a glenoid fossa is rendered deep and capacious, affording an ample socket for articulating with the powerful mandible upon either side.

Near the inner side of the postglenoid process occurs another conspicuous apophysis, which appears to correspond to the vaginal process of anthropotomy. It is triangular in outline and produced anteriorly into a sharp spine. The glenoid articular surface extends over the postglenoid process, while between it and the base of the cranium we find the orifice of the canal for the Eustachian tube, the foramen for the internal carotid artery, and other small foramina for nerves and vessels in the immediate vicinity.

The basioccipital area is smooth, rather broad, and mesially divided by the above-described crest. We find no tympanic bullæ as they occur in many of the carnivora and other mammals. Each exoccipital area in its place is roughened, flat, and quadrilateral in outline.

Foramen lacerum posterius, the foramen stylomastoideus, and the condylar foramen all occupy their usual sites, the first named being large and oval in outline. The external auditory meatus is small, vertical, and slit-like, being situated in a deep recess posterior to the glenoid fossa. A thin, sharp rim of bone surrounds it upon all sides save above.

The ossicula auditus, presumably consisting of the usual malleus, incus, and stapes, will not be described here, while it is much to be regretted that the osseous parts of the hyoidean apparatus are missing in all three of these specimens. (The hyoid and larynx are described at the end of this paper.)

*Cynocephalus* possesses only a fairly large cranial cavity. In two of these specimens (2, 3) it has been considerably shattered by shot, and in the remaining one (1) the vault of the skull was not removed for an examination of the interior of the cranial casket. However, a view of it was obtained in another (3), but the characters presented nothing remarkable. The cribiform plate is large and subcircular in outline; the perforations in it are rather minute and numerous. The "sella turcica" and the clinoid processes are but feebly developed, while the usual foramina are to be observed in the vicinity. More posteriorly, at the hinder part of the cavity, a raised osseous crest marks the line for the insertion of the tentorium cerebelli, dividing the fossa for the cerebrum from that for the cerebellum, the latter not being especially capacious. The internal vault of the cerebral cavity is fairly marked by the convolutions of the brain; a raised osseous crest in the median line divides the left from the right side. The internal entrances of the usual neural,

venous, and arterial foramina are all to be observed at their ordinary sites.

As above remarked, *Cynocephalus* has a powerful mandible or lower jaw. (Plate I, figure 2, and Plate II, figure 4.) Taken as a whole this bone possesses a deep U-shaped outline, with the limbs of the body and the rami rather more diverging in some specimens (1) than in others (2, 3), where they may be quite parallel to each other anteriorly beyond its ramal portion. In front the symphysis is strong, deep, and firmly united, exhibiting a prominent mental process below, while its concave inner surface is smooth. Beyond either ramus the body of the jaw is thick from side to side, with its straight, upper, alveolar margin deeply marked with the sockets of the various teeth, and its lower border, parallel to it, rounded and smooth. The mesial line of the symphysis is directed from below, forward and upward, at an angle of about 45° with the imaginary mid-longitudinal line of the bone. The ramal portion of either limb is considerably deeper than the body, extending both above and below it, being as a whole gradually turned outward from it at an angle of 35° or more. Its outer surface is smooth and looks forward and outward, while its inner surface, also smooth, presents two conspicuous ridges for the pterygoidal muscles and is directed backward and inward. Again, the outer surface is very moderately convex below, as compared with the markedly concave inner surface. At the upper anterior margin of this concavity we note the inferior dental foramen situated almost in line with the alveolar border, at the base of the coronoid process, and some 6 millimeters posterior to the last molar tooth. The angular border is thickened, circular in outline, and finished off with a raised rim. Externally and superiorily, the ramal portion is concave, that is, between the coronoid and condylar process, a concavity that is gradually lost as we approach the middle of the ramal area, or surface, upon this aspect of the bone.

The mental foramina, upon either side, appear to be three or four in number, a few millimeters apart, and all in the longitudinal line extending from a point opposite the second incisor to include the last premolar, well within the lower border of the dentary portion of the jaw. Between the base of the coronoid process and the last molar tooth there exists a deep pit, the use of which can not here be determined, although in life it probably harbors the tendon of insertion of the buccinator muscle.

The coronoid process is, as a whole, situated above any other portion of the mandible, being flattened from side to side, slightly thicker at the base than above, and shaped like a cat's claw with the apex directed backward. (Plate II, figure 4.) It is directed upward and outward at an angle of about 45° with the transverse diameter of the condyle, from which it is separated by a considerable interval. The axis of the condyle is perpendicular to the median plane, its smooth articular surface extend-

ing entirely over its superior convex aspect. From before backward it measures about 2 millimeters; transversely it averages 1 centimeter, being very slightly larger at its inner than at its outer extremity; a concavity occupies the entire surface of the former, while the latter is bluntly rounded off. In very old specimens, and perhaps in others, the two limbs of the mandible after prolonged maceration part company at the symphysis, exposing there a roughened, subelliptical surface, whose major axis is identical with the symphysial axis.

### THE TRUNK SKELETON.

There has been given on a former page (p. 142) of the present memoir, the number of vertebræ in the spinal column of two species of *Cynocephalus,* ar recorded by Flower, viz, three specimens of "*G. volans*" and one specimen of "*G. philippinensis.*" This second exhibits, if correct, some remarkable variations in this part of the skeleton.

Flower discovered 7 cervical vertebræ in all four of the specimens he examined, while he found 13 thoracic in two "*G. volans*;" 14 in another; and 14 in "*G. philippinensis.*" Still more remarkable is the record he left with respect to the lumbar vertebræ present in this animal, for in "*G. volans*" these ranged 5, 6, and 8, while in the specimen of "*G. philippinensis*" there were 6 of these vertebræ. Coming to the sacrals, he claims to have found 5 in two of "*G. volans,*" 4 in another, and 4 in "*G. philippinensis.*"

As *Cynocephalus* has a long slender tail, we are not greatly surprised at any variation that may occur there, especially as some of these vertebræ may be lost for one reason or another, and at the best they are likely to vary somewhat in this division of the column. Flower found in "*G. volans*" 14+, 15, and 17 caudal vertebræ, and 17+ in the specimen of "*G. philippinensis*" he examined. Taking his total count for the vertebral column it stands thus: "*G. volans*" 45+, 45, and 50, and for his specimen of "*G. philippinensis*" 48+. In other words no two specimens, without regard to species, were in agreement in this particular.

Upon careful count, the three specimens here being examined show the following for the number of vertebræ in the spine:

*Number of vertebræ in Cynocephalus.*

| Specimens. | Cervical. | Thoracic. | Lumbar. | Sacral. | Caudal. | Total. |
|---|---|---|---|---|---|---|
| Professor Steere No. 1 | 7 | 13 | 9 | 3 | 19+ | 51+ |
| Bureau of Science No. 2 | 7 | 13 | 8 | 3 | 18+ | 49+ |
| Bureau of Science No. 3 | 7 | 13 | 7 | 4 | 16+ | 47+ |

If by a + in his account of the number of caudal vertebræ present Flower meant that certain terminal caudals were missing, no such meaning is here intended to be conveyed. In the above table a + does not mean

that the skeleton with respect to the number of caudal vertebræ is imperfect in any of the specimens examined, but that the skeleton of the tail is finished off distally by an apparently rudimentary vertebra which lacks the posterior moiety. The truth of this has been confirmed in my specimens by the use of the microscope. For example, caudal vertebræ 11 to 15 in specimen number 2, very much resemble, upon a casual glance, some of the joints of the manus or pes, with a shaft and articular extremities. Now the minute terminal vertebra of the tail in specimen number 2 (and in others) if compared with a phalangeal joint, appears to have been broken in two at the middle of the shaft, or at a point that in reality is the middle of the centrum of the vertebra. The + stands for this "nib" or rudimentary terminal caudal vertebra in my specimens, and as such is entitled to recognition in the total count. (See figure 17, plate V.)

From an examination then of six individuals, three of Flower and three here, it may be stated with certainty that the number of vertebræ in the spinal column of *Cynocephalus,* irrespective of species, is markedly variable, after we pass the 7 cervicals, which are invariably present in all specimens. There may be 13 or 14 thoracic vertebræ (bearing ribs); from 5 to 9 lumber vertebræ; from 3 to 5 sacrals, or those that fuse together to form the "sacrum;" and, finally, from 14 to 19 caudals, which in most cases possess in addition (a +) a rudimentary one at the termination of the tail series.

Throughout the class Mammalia, even including man, the number of caudal vertebræ present in any particular species is subject to considerable variation. This becomes less and less the case as we pass from the tail to the cervical division of the spine, where with but very few exceptions 7 is the rule. *Manatus* among the Sirenia has but 6 cervical vertebræ; which is also the case with *Cholœpus* among the Edentates, while in the same group (Edentata) *Bradypus* possesses 9. At the present writing no other exception to this rule is known to me in the class.

The count may be made to vary, too, by the number we elect to represent the pelvic sacrum. In *Cynocephalus* as in other mammals, man included, the number varies also with the number that fuse together to form the sacrum. Where they have thus coössified, the bones so united have been here considered as sacral vertebræ; 3 in two instances; 4 in another. In man they vary from 4 to 6.

All these facts led Flower [15] to state that—

> It must never be forgotten that although the division of the vertebral column into distinct regions is convenient for descriptive purposes, at the contiguous extremities of the regions the characters of the vertebræ of one region are apt to blend into those of the next, either normally or as peculiarities of individual skeletons.

[15] Osteology of the Mammalia, 78.

In describing the spinal column in any mammal it has been the rule of the present writer to consider all those vertebræ between the skull and the first one in the chain, proceeding backward, that bears a pair of true, free ribs, as cervical vertebræ; all those bearing a pair of true, free ribs, as dorsal or thoracic vertebræ; all those between these last and where they coössify to form the "pelvic sacrum," as lumbar vertebræ; all those fusing together between the ilia of the pelvis, as sacral vertebræ; and all the rest to the end of the column, or chain, as caudal vertebræ. This rule has been here applied to *Cynocephalus*. (Figures of vertebræ will be found upon Plates II to V of the present memoir, that is figures 7, 8, 10, 11, 12, 13, 14, and 17.)

In describing the spinal column of the insectivore here being considered, the specimen furnished by Steere has been selected; constant references, however, will be made to the others, designating them as 2 and 3, respectively, as already indicated.

There is nothing especially unusual in the vertebral column of *Cynocephalus,* as it is strictly mammalian in character, with all of the vertebræ reduced to their simplest forms for an insectivorous animal. Even in the matter of number these bones may agree with others among the Insectivora, as in the case of the common European mole (*Talpa europæa*), which has in its vertebral column 7 cervical, 13 thoracic, 6 lumbar, 5 sacral, and 11 caudal vertebræ, the tail simply being somewhat longer in *Cynocephalus.*

Viewed in its entirety in the latter it is to be noted that the atlas is by far the largest vertebra in the chain; the axis is the next in size and is considerably smaller, being about equal in bulk to the last lumbar. The succeeding five cervical, and the first dorsal are all large vertebræ, which very gradually decrease in size as we approach the dorsal region of the spine. From the second dorsal to the seventh inclusive the vertebræ continue gradually to diminish in size; except the terminal caudals, the seventh dorsal is about the smallest one in the column; beyond the seventh dorsal the vertebræ gradually increase again, become much larger and of different character in the lumbar region, and terminate with the largest one of all, which articulates with the anterior vertebra of the pelvic sacrum. The first lumbar bears considerable resemblance to the last dorsal, but is distinguished by not supporting a pair of facets for ribs.

The vertebræ composing the sacrum fuse very solidly, but the lines of demarcation between the central and the neural spines are always more or less distinguishable, more so in some specimens (1 and 3) than in others (2). The first caudal vertebra, which is free, resembles the last sacral, and the same may be said of the second, third, and fourth caudals, although the resemblance becomes gradually less evident as we proceed toward the end of the tail. This dissimilarity continues to increase rather rapidly, although never abruptly, as we follow the caudal series to its

termination, each succeeding vertebra having its various apophyses disappear, becoming lengthened and much simpler in character, straight and subcylindrical, and with interarticulations of the most primitive kind. As we come to the last four or five caudals they gradually shorten again, being in this region represented by mere delicate straight rods, with slightly enlarged articular ends, and finally terminate in a minute osseous tip, the smallest vertebra in the entire series, hardly worthy of the name (figure 17).

No neural spine occurs upon the atlas vertebra, although a very prominent one, arising from the entire length of the neural arch is to be found upon the axis. Its superior border is convex from before, backward. The neural spine in the remaining five cervicals is very markedly reduced in size, in each bone being represented by a mere stumpy process. In the first dorsal it starts to increase again, being situated posteriorly and directed backward. It then gradually increases in size; becomes nearly vertical, quadrilateral in outline, and almost imperceptibly dwarfs once more to include the eighth dorsal, when again its proportions increase, and this continues as we pass through the lumbar region. In the mid-series of the vertebræ in this latter locality in the Steere specimen, the neural spine is a very conspicuous feature of the bone, being lofty, quadrilateral in outline, and with a thickened superior border; it extends the entire length of the neural arch, being about one-half the size on the last lumbar vertebra. In other individuals these neural spines are not nearly so conspicuous (figure 17) as the ones just described (figure 7, Plate II).

Neural spines are always present upon the sacrum, but here by fusion they constitute a single plate of bone, being individualized only by the thickened superior borders (figure 8). This plate is not so high posteriorly as it is in front, while at the same time it extends the entire length of the sacral neural arch.

On the leading caudal vertebra we find a fairly well-developed neural spine of about the same size as the one on the last dorsal vertebra. It is centrally situated. This is the case with the next two succeeding caudals, but in these the neural spine is becoming aborted, while in the fourth caudal it may be only just evident, to entirely disappear in the vertebra next following, and not be produced again for the balance of the vertebral elements in the skeleton of the caudal appendage.

A mere mesial raised line represents the hæmal process or hæmapophysis, in the axis and the third cervical vertebra; for the rest of the column no such structure is present, while the caudal vertebræ appear to be entirely lacking in chevron bones. These last are found in many mammals, as, for example, among marsupials, the Edentata, Cetaceæ, many rodents, carnivores, and even in some Insectivora, as *Rhynchocyon,* where, according to Flower, they "are well developed and bifid." [16]

[16] Osteology of the Mammalia (1885), 73.

Returning to the atlas (figure 10) we find, in addition to characters already ascribed to it, that it possesses upon its anterior aspect the usual two, extensive, cup-shaped facets intended for the condyles at the back of the cranium. They face forward and inward in about equal proportions, and are completely out of view when the vertebra is regarded from directly above. The neural canal is short and cylindrical, being covered by the broad neural arch above, but very slightly so protected ventrally. Each apophysial, transverse, lateral expansion is twice pierced by foramina; the anterior ones are for the vertebral arteries and suboccipital nerves, the other pair, entering the neural canal at its sides, are for the vertebral arteries. On the posterior floor of the neural canal, the articular surface for the odontoid process of the axis and the entire fore part of the latter bone, save its neural spine, are continuous, thus affording very considerable play between the two bones. The under sides of the nearly horizontal, lateral, apophysial plates of the atlas are decidedly concave, with the mesial, almost entirely aborted, hypophysial tubercle standing between them behind.

This ventral surface of the atlas is bounded in front by a deep concave articular border with the concavity directed backward. A similar border with thickened edge forms the posterior boundary; its concavity, which is not so profound, is directed forward. Between the nearest points of these two concave borders in the middle line, the separating isthmus of bone measures only a few millimeters. The margins of the lateral edges of this vertebra are sharp and convex outward.

Passing next to the axis, or second cervical vertebra, it is to be noted that its odontoid process is but fairly well produced, being bluntly triangular in form, considerably compressed from above, downward, and together with the rest of the articular surface on that aspect of the bone, projecting entirely beyond the neural spine above it. This is by no means always the case in mammals, for among certain Felidæ and Canidæ it may be observed that the anterior projection of the neural spine in this vertebra overhangs the odontoid process. There are no prezygapophyses, while the postzygapophyses are much aborted, the elliptical articular facets, which they support in other vertebræ being represented, one on either side, by similar surfaces situated beneath the neural laminæ. They project beyond the small and vertically much compressed centrum, which presents, posteriorly, a rather large facet for the third vertebra. (Plate III, figure 11.) The transverse processes are moderate in size, triangular in outline, and much compressed in the vertical direction. No foramen for the passage of the vertebral artery, on either side, is to be found in the axis, while the cylindrical neural canal is much smaller than it is in the atlas. In fact it has about the same caliber and form throughout the cervical series as it has in the axis now being considered.

The remaining five cervicals are all very much alike, and we find each

of them perforated upon either side, in the longitudinal direction, by the foramen for the vertebral artery. In each the centrum is much compressed from above, downward, which results in giving the articular facet at either end a transverse elliptical form, the concave one being behind, the convex one in front. The prezygapophyses are quite individualized and project directly forward beyond the centra and the neural arch. Postzygapophyses practically agree with what has been described for the axis. All these vertebræ have a broad, compressed appearance with their flat ventral aspects quadrilateral in outline. Small and stumpy in the third cervical, the transverse processes become gradually more conspicuous to include the seventh, or last cervical, where they are produced both forward and backward from a broad common pedicle.

Among the leading dorsal vertebræ the centra are much compressed as we found them in the cervicals, but they gradually become more cylindrical in form to the close of the series. Reniform in outline, the articular facets at either end have their concave edges upward.

Greatly reduced in size and caliber throughout the dorsal region, the neural canal is slightly compressed from above, downward, in the first few dorsals, finally to become cylindrical among the ultimate ones. This continues to be the case through the lumbar vertebræ, until we arrive at the last lumbar, where the canal is very much compressed from above, downward, and with this form passes through the sacrum and the first four caudal vertebræ. On the fourth caudal the spinal cord receives its last and very scant osseous protection, passing through a delicate little arch on the superior aspect of the bone, posteriorly.

Among all the dorsal vertebræ the diapophyses, or transverse processes, are short and thick, and in all cases project directly outward from their bases. At their nether extremities we note the usual facets for the tubercles of the ribs articulated with them at these points. The capitular facets for the heads of the ribs are shared in each case throughout the dorsal series by two vertebræ, by which is meant that one-half of the facet (a demifacet) is on the centrum of one vertebra and the other half on the side of the centrum of the vertebra next following it. No exception to this rule has been met with in the three specimens examined. Zygapophysial processes here present their usual mammalian characters, the postzygapophyses only becoming differentiated as true processes in the last few bones of this region.

The intervertebral foramina for the entire spinal column are formed about as they are throughout the mammalian series, including man. They are large in the cervical region, very much smaller in the dorsal section, and increase in size again in the lumbar where they are longitudinally slit-like, and are found in each case between the centrum and the long, backwardly directed, spiny anapophysis on either side, at the posterior end of the vertebra (figure 7).

These anapophysial processes of the lumbar vertebræ, where present, are quite characteristic. Each one on either side forms a deep notch with the postzygapophysis next to it on the same vertebra. Into this notch, when the bones of the spine are normally articulated, fits the prezygapophysis (of that side) of the next succeeding vertebra, the combination making a very close interlocking articulation, which, when taken altogether for the six leading lumbars, accounts for the remarkable fixity and stability of this part of the column in *Cynocephalus.* In the last two lumbar vertebræ these anapophysial processes are entirely aborted, as are the transverse processes in the first two lumbars. After that, however, these diapophyses begin to appear again, being represented by thin, quadrilateral, horizontal plates of bone of good proportions. They are thick and strong in the last lumbar, and claw-shaped in the three that precede it with the apices of the claws directed to the front. (Plate IV, figure 13.) Metapophyses of a very rudimentary type are also to be seen in the mid-lumbar vertebræ; in any case the most of the projection belongs in reality to the anterior zygapophysis, an exception being found in the last lumbar vertebra, where these processes are much better defined and rather more prominent.

In Steere's specimen the sacrum is a very solid bone, composed of three vertebræ thoroughly fused together. The leading one has double the bulk of the last, while the middle one is massive anteriorly and slopes away behind (Plate IV, figure 14). Anteriorly, the first sacral presents the usual facets, processes, and surfaces to articulate with those on the hinder aspect of the last lumbar. So, too, the posterior face of the third sacral is similarly modified in order to meet the requirements of an articulation with the anterior face of the first caudal vertebra. Laterally, the entire mass of the first sacral and the anterior moiety of the second, are enlarged, thickened, and curved ventrad to support on their outer aspect a large, subelliptical, articular surface for the ilium of the same side. This surface looks upward and outward, and the major axis of the ellipse is in line with the longitudinal axis of the spinal column, being parallel to the long axis of the ilium when the bones are normally articulated. There are two pairs of foramina on the ventral surface of the sacrum for the exit of the anterior roots of the spinal nerves. Similar pairs of foramina, for the posterior roots, occur on the dorsal aspect of the bone directly opposite these; then the foramina for the pairs of roots of the spinal nerves both anterior and posterior to these are only completed when the last lumbar and first caudal vertebræ are in position and duly articulated in the column, being represented only by shallow notches in front and behind when we study the sacrum as a single bone.

Considerable compression in the vertical direction is noticed in the first four caudal vertebræ. The fifth is rather stocky, after which they commence to elongate and lose their apophyses and the other usual

vertebral characters of the bones in the fore part of the column. The lateral processes, especially, are developed in the first four caudals, most so in the third and fourth, where they are extensive horizontal plates with circular limiting borders. Zygapophysial processes are well developed in the leading caudals, particularly the prezygapophyses, which subsequently, as we pass down the skeleton of the tail, become a pair of rounded tubercles situated side by side on the supero-anterior aspect of the bone. These persist in a number of vertebræ as we pass toward the end of the tail.

On the ventral aspect of the skeleton of this part of the vertebral chain in Steere's specimen, between the sixth and seventh and the seventh and eighth vertebræ, and situated directly over the intervertebral articulations, we note a pair of minute ossicles, ellipsoidal in form, and placed side by side, at an interval of about one millimeter. They are perfectly free and are held in place by delicate ligaments. Possibly similar pairs may be found posteriorly between a few more vertebræ, but after that they surely disappear altogether. These last have evidently been lost in the specimen, and it is fair to presume that these ossicles probably represent rudimentary chevron bones.

Flower,[17] under the Insectivora, makes no mention of the ribs and sternum, although he lightly touches upon them for *Talpa, Sorex, Erinaceus,* and *Rhynchocyon.*

Viewed as a whole the osseus framework of the thorax in *Cynocephalus* is quite in keeping with what we meet with in this part of the skeleton in any average mammal, being decidedly more so than in *Talpa,* although the mole and the colugo each possess 13 pairs of ribs.

The chest capacity of *Cynocephalus* is considerable, notwithstanding the fact that it is much contracted anteriorly, where it is bounded by the first pair of ribs, the first dorsal vertebra, and the presternum. From this region it gradually, though very uniformly, expands to the plane of its posterior termination, where it has an average transverse diameter of 6 centimeters.

Owing to the greater size of the leading dorsal vertebræ and to the small dimensions of the ribs themselves the first three pairs of ribs have, upon either side, greater intervals between them than any other members of the series. These ribs are somewhat roundish in form, although exhibiting a disposition to flatten at their vertebral ends as we pass backward. In the fourth pair this flattening associated with an increased width is pronounced, and from thence on is continued to include the last pair. This accounts for the decrease in the width of the intercostal spaces after passing the third pair of ribs, so that each intercostal space is about equal to the ribs that bound it. There is very little difference in the width of the ribs from the fifth to the thirteenth pair, inclusive,

[17] Osteology of the Mammalia, 94–96.

and each one is nearly as wide at its sternal end, where it is joined by a costal rib, as it is at its angle. Those forming the first pair are the shortest in the series; the sixth, seventh, and eighth pairs are of about equal length and are, at the same time, the longest ones of all.

Seven of the leading pairs of ribs are joined to the sternum through the intervention of costal ribs; in the eighth pair the costal ribs are very long and attenuated, and lack but very little of meeting the distal extremity of the mesosternum. After this they rapidly shorten, the ninth, tenth, and sometimes the eleventh articulating in sequence with each other's lower borders; the twelfth and thirteenth are thus joined by a ligamentous membrane only, and are practically floating costal ribs. (Figure 17.) The first pair of costals are the shortest of all that unite the vertebral ribs with the anterior end of the presternum, occupying facets, one upon either side, just behind where the clavicles articulate. Like all the others they are curved, the concavity of the curvature looking forward. From the first to the last, or seventh, pair of costals this curvature continues, although it is here principally, indeed, almost entirely confined to the outer third of the bone, especially in the last two or three pairs. They become progressively longer as we pass backward, and all seem to be composed of true bone, although a little elementary in character. The distal pairs of costals are still more cartilaginous, but there is evidence of osseous tissue in all of them. At their sternal ends they articulate upon facets situated *between* the joints of the presternum and mesosternum, the sixth and the seventh articulating at the distal end of the posterior joint of the mesosternum. None of the costals ever articulates with the xiphisternum.

All the thoracic ribs articulate with the dorsal vertebræ in the way usual among mammals and they present the common characters of these bones. They are somewhat narrower in some specimens (1) than in others (2, 3), but wide or narrow, any single rib in mid-series varies but little in its own width from angle to costal articulation. All present the usual curvature, although here it involves almost the entire continuity of the bone and is most pronounced dorsad.

If we select a "true rib" of the eighth pair as an example we find that its capitulum is well developed; the elliptical double facet is rather large and placed longitudinally on the bone. The "neck" is but moderately constricted; the "tubercle" is but feebly pronounced, and owing to the short transverse process of the dorsal vertebra, is quite close to the capitulum. The "angle" is but very faintly indicated, and is entirely absent in the last three pairs of true ribs. As in the rest of the series, the "body" of the twelfth rib is very flat with rather sharp anterior and posterior borders. These last in Steere's specimen are far more rounded. Posteriorly and at the same time dorsad, there is a faint groove running down the border of this rib. It harbors in life the intercostal vessels and

nerve, while its borders give attachment to the internal and external intercostal muscles.

A very shallow concavity, or pit, occupying the ventral end of all the true ribs, is intended for articulation with the outer extremity of the corresponding costal rib.

Between the head and tubercle in most of the true ribs of this animal we meet with a single nutrient foramen, usually upon the posterior aspect of the bone. It is extremely minute in some of the ribs and varies somewhat in locality.

*Cynocephalus* possesses an ordinary and rather stout sternum, the parts consisting of spongy bone overlaid by an extremely thin outer covering of compact tissue. As usual in most mammals it is divided into the presternum (manubrium), the mesosternum (gladiolus, etc.), and the xiphisternum (ensiform cartilage, or xiphoid appendage, etc.). Sometimes the parts of the mesosternum are designated as sternebræ, the whole being frequently called the "breast bone." (Figure 17.)

The presternum is here short and trihedral in form, with its blunt third angle situated mesially, and articulating in life with the anterior end of the first sternebra of the mesosternum. Its outer anterior angles are for articulation with the first pair of costal ribs. The sharper antero-mesial angle has, running between it and the distal end of the bone, a low mesial raised crest which stands between the lateral aspects of this joint of the sternum. Dorsally it is flat, while anteriorly the triangular surface is very moderately concaved. Its longitudinal diameter averages about 8 millimeters, and it is scarcely any wider at its widest part in front.[18]

Passing to the mesosternum we find it composed of four sternebræ closely resembling one another in form, and differing but little in the matter of size. They are vertically compressed, smooth bones, narrower at their middle than at their extremities, and in life articulate with each other in the manner usual among mammals. They average about 4 millimeters in width, and rather more in length, the anterior one being 5 millimeters long and the third or longest one about 8 millimeters long. They present the usual facets at their anterior and posterior angles for articulation with the costal ribs.

The xiphisternum varies considerably in form, although it may be described as a cartilaginous appendage, about as long as the third sternebra. Occasionally it appears to be in two bits, one behind the other, the anterior one exhibiting a very faint disposition to ossify. Viewing the thorax from in front, it will be noticed that in most specimens the

[18] The presternum in *Cynocephalus* is entirely different from that bone as we find it in the mole (*Talpa europœa*), as will be seen by examining Flower's figure of the latter. Osteology of the Mammalia, figure 34.

sternal ends of the seventh pair of costal ribs articulate with each other in the mesial line, and at the same time with the distal end of the last sternebra. The xiphisternum is united to the mesosternum at the dorsal aspect of this triple articulation; this is an unusual arrangement among mammals, possibly not existing in any other known species. It is entirely different in *Talpa,* and very probably in other insectivores.

In the articulated skeleton the xiphisternum is about opposite the tenth dorsal vertebra, and the entire sternum has an average length of 4.5 centimenters.

[*To be concluded.*]

# ILLUSTRATIONS.

## Plate A.

Skeleton of a flying lemur. By permission. Reduced. From the mounted specimen in the collection of the United States National Museum.

## Plate I.

Fig. 1. Basal aspect of the skull of *Cynocephalus;* lower mandible removed, and a few teeth missing. Adult. Very slightly enlarged. Specimen from Professor J. B. Steere.

2. Left lateral view of the skull of *Cynocephalus*, with lower mandible articulated *in situ*, and the dental armature complete. Hyoidean apparatus removed. About adult. Very slightly enlarged, and in same proportion as figure 1. A specimen from the Bureau of Science, Manila, P. I.

## Plate II.

Fig. 3. Superior aspect of skull of *Cynocephalus*, lower mandible removed. Same specimen as shown in figure 1 of Plate I. Exact natural size.

4. Lower mandible of *Cynocephalus* seen upon direct superior view. Dental armature complete. This jaw belongs to the skull shown in figure 3. Exact size of the specimen.

5. Left scapula of *Cynocephalus* seen upon direct ventral view, and natural size. The absence of the superior angle, and the foraminal vacuities in the blade are normal. The rounded superior angle of the right scapula in this specimen is perfect. The bone belonged to the same individual from which the skull and mandible were taken shown in figures 3 and 4.

6. Left femur of *Cynocephalus* seen upon anterior view and slightly enlarged. Note the almost entire absence of the pit for the ligamentum teres. From the same specimen as figures 3, 4, and 5.

7. Lumbar vertebræ of *Cynocephalus*, being the third to the seventh, inclusive, and seen upon left lateral aspect. Natural size; from the same specimen as the other bones in this plate.

PLATE A.

Fig. 1.

Fig. 2.

PLATE I.

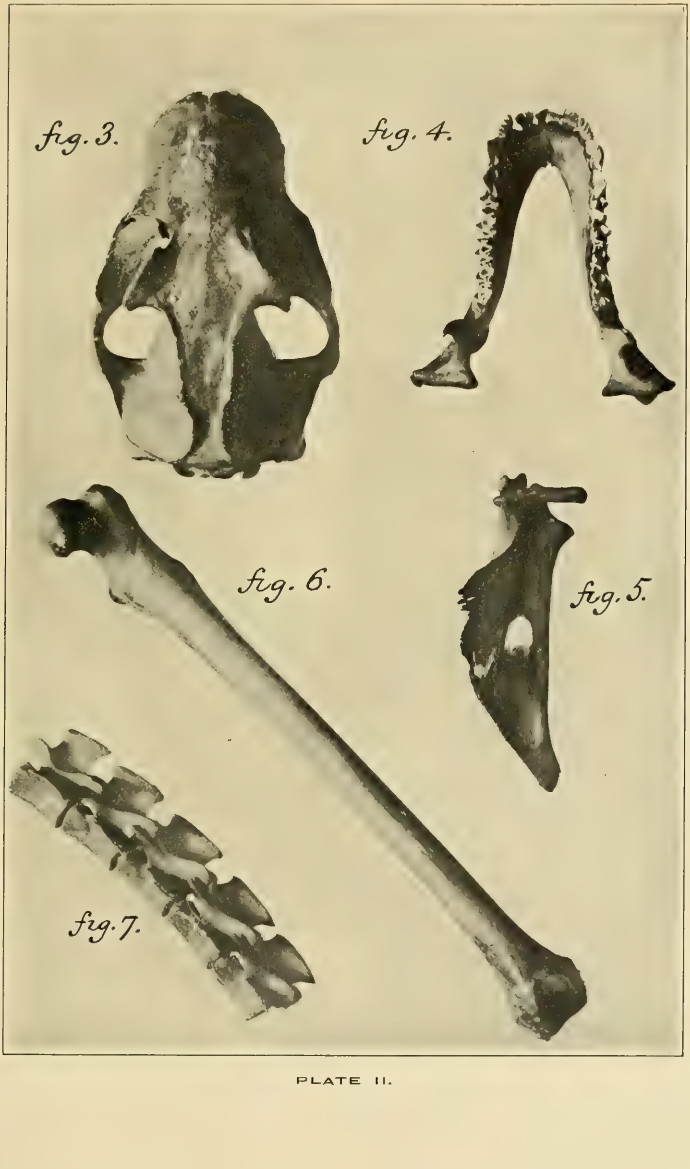


PLATE II.

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## NEWLY DISCOVERED BREEDING PLACES OF PHILIPPINE SEA BIRDS.

By DEAN C. WORCESTER.

Gulls and terns in considerable variety have long been known from the Philippines. Brown boobies, too, have been recorded by various ornithological collectors, but only one specimen of the red-legged booby, and that an immature individual, had been collected in the Islands prior to June 25, 1910, on which date, when crossing the Sulu Sea between Kalusa Island and Puerto Princesa, Palawan, I saw a large flock of these birds hovering over a school of fishes. I had the captain change course slightly so as to take the steamer near them, but they dispersed before us. Several individuals flew within long shotgun range of the ship and I had the good fortune to bring down a fine, adult specimen which fell into the sea but was recovered by stopping the steamer and lowering a boat.

On July 13, 1910, on which date I was exploring the islands in Green Island Bay on the east coast of Palawan when I was heading for Reef Island, I saw, on the starboard bow, a sandbar rising not more than a meter above the sea, the tide at that time being full. While I was examining it through my field glasses, a large flock of terns suddenly rose from it, and after circling for a few moments settled again. Although the breeding season for most birds was then well over, I was at a loss to understand why these terns should be gathered in such numbers upon a perfectly bare sandbar unless they had eggs or young there, so ordered the steamer stopped and a boat lowered, and proceeded to investigate.

The terns did not again take wing until we were close in shore, and then refused to leave the immediate vicinity of the reef, circling close over our heads. Nearly all of the individuals were black-naped terns, *Sterna melanauchen* Temminck, but by pure accident I killed a single specimen of the oriental roseate tern, *Sterna gracilis* Gould, which had never before been taken in the Islands. By watching sharply, I was then able to pick out and kill two additional specimens, recognizing them in flight by their red legs.

We found numerous eggs on the reef. They were deposited singly or in pairs in slight depressions in the sand, lined in a number of instances with bits of sea shell and of white coral.

So far as I am aware, this was the first time that terns have been found breeding in the Philippines.

On August 24, 1910, I joined Governor-General Forbes and the Secretary of War on board the steamer *Rizal* at Capiz, Panay, and was greatly interested to learn that on their way from Jolo to Puerto Princesa they had landed on Bankoran Island in the middle of the Sulu Sea, finding great numbers of brown and red-legged boobies and some of the greater frigate birds, as well as a few terns. They had obtained specimens of all the species observed and had put them in cold storage so that I was able to make positive identifications. They told me that there were many nests in the trees and on the ground, but that only one egg had been obtained. Upon examination I found that the egg was obviously that of a booby, but whether of a brown or a red-legged booby it was impossible to say.

On September 16, 1910, I had occasion to leave Manila on a trip to the west coast of Palawan and subsequently passed through Balabac Strait and sailed north along the chain of islands and shoals which extends in a generally northeasterly direction through the Sulu Sea. Bankoran Island was reached early on the morning of September 22. Fortunately the weather was calm and we were able to land at the southwestern end of the island at 6 o'clock. From the steamer we had seen immense flocks of boobies circling about the island, which is covered throughout nearly its entire extent with trees, but has at its western end sand-spits, partially overgrown with grass and bushes, while at low tide rough masses of coral rag are left exposed by the receding water.

We at once discovered that the red-legged boobies, *Sula piscator* (Linnæus), were nesting in the trees, while the brown boobies, *Sula leucogastra* (Boddaert), were nesting on the ground. A few moments' observation sufficed to show that a number of red-legged boobies, which we found in, or close to, nests upon the ground, were not their owners as we had at first supposed, but were stealing nesting material from them in the absence of the brown boobies which had built them.

With very few exceptions the nests on the ground contained no eggs.

We soon discovered this to be due to the fact that two boat loads of Moro egg-hunters had on the previous afternoon removed every egg from the ground nests. Their boats were still anchored on the shoal to the north of the island and were found to contain both boobies' eggs and sea turtles' eggs in large numbers.

Apparently they had been too lazy to climb the trees after the eggs of the red-legged boobies, some of which we were, therefore, able to collect.

The Moros assured us that by noon there would be plenty of fresh eggs in the nests of the brown boobies, and this proved to be the case. The boobies of both species were so tame that we experienced no difficulty in catching alive as many as we needed for specimens, and we were also able to secure a very interesting series of photographs, and to observe closely the nesting habits of the birds of both species. The male and female brown boobies were readily distinguished by the fact that the former had the bare skin at the base of the bill and on the throat dark blue, while in the latter it was bright lemon yellow.

The ground nests of the brown boobies were made of bits of rotten wood, dead leaves, small branches, and twigs to many of which green leaves were still attached. In fact we saw the birds breaking such twigs from the trees. The female usually remained sitting bolt upright in her nest, while the male brought nesting materials which he turned over to her. These she promptly put in place, not infrequently lifting and putting down repeatedly a given leaf, twig or bit of punky wood until she had placed it just to suit her. Occasionally the materials brought by male birds were rejected, and as a rule when the latter endeavored to put any material in place in the nest, as was sometimes the case, it was thrown out by the females, which were evidently determined to construct their houses in strict accordance with their own ideas and to keep the male birds under proper discipline.

In many cases the nests were in close proximity to each other and the male birds were constantly trying to steal materials from other nests. This led to vigorous vocal protest from the rightful owners and not infrequently to rough-and-tumble fights as well. The fights were all of short duration and quite bloodless. In no instance could we see that one booby really injured another.

The red-legged boobies not only stole nesting materials from their brown relatives, but quarreled shamefully among themselves.

Every bird which attempted to fly through the air with a fairly sizeable branch in its mouth was set upon by half a dozen others, which, in their efforts to make it drop its burden frequently drove it to the ground where it was vigorously mauled until it relaxed its hold upon the branch. Some other bird then attempted to fly off with it and was set upon in turn. These contests seemed always to end when a lucky individual succeeded in getting to its nest with the coveted branch.

Both brown and red-legged boobies rose readily from the ground, and flew among the trees with greater skill than one would have expected them to display, but if caught in grass or brush they were very helpless.

Only a single frigate bird was observed, and this individual promptly left the island on our arrival.

The eggs of the two species were indistinguishable. Each had a white, chalky outer layer, with a harder underlying layer which was very light blue in color. The female brown boobies were most reluctant to leave nests which contained eggs, and in some instances would not do so until actually pushed off. Upon the near approach of any member of our party, females which were sitting upon eggs manifested their uneasiness and nervousness by croaking and by picking up and laying down bits of nesting material. In a number of instances they displayed great courage, staying by their eggs and pecking vigorously at the hands of those who attempted to dislodge them. When taking photographs with a Graflex camera I had no difficulty in getting within four feet of nesting birds.

In the course of the morning a fresh breeze sprang up and the tide which had been low when we landed rose so that we could not reëmbark on the windward side of the island but had to send the boat around to the leeward side. We returned to the steamer at a quarter past twelve and I requested the captain to sail for Tub-bataha, thinking we might find sea birds on one or another of the several small islands which rise from this extensive shoal. The captain, however, objected, as we should necessarily have arrived at night. The position of Tub-bataha is not definitely known, and there are a number of bad outlying shoals, so that he did not deem it prudent to stand on and off in the dark. As an alternative he suggested that we visit Maeander Reef, where, according to the sailing directions, sea birds had been seen in large numbers.

At 4.30 in the afternoon the steamer changed course sharply to the south. Maeander Reef had been sighted from the masthead considerably to the south of the point where it is shown on the chart. We reached it in half an hour and found it to be a mere sandbar about 200 meters long by 150 wide, rising not more than two meters above the water. It is surrounded by an extensive shoal over which we were forced to wade and is absolutely devoid of vegetation. Drift wood lodged at its highest point showed that the waves break clean over it in very heavy storms, in spite of the shoal which one would suppose would prevent any such result.

While still at a considerable distance, we saw through our glasses flocks of birds flying over the reef, and regiments of brown boobies sitting in long lines upon the shore. As we drew nearer we made out groups of northern Bergius's terns, *Sterna boreotis* Bangs, with young

which were big enough to run about freely and to take to the water upon our nearer approach. Upon walking up the steeply shelving sand beach we beheld a wonderful sight. Enormous numbers of sooty terns, *Sterna fuscata* Linnæus, were standing on the sand in great groups, containing fully adult birds in breeding plumage, immature birds which were dark brown or black with some white-spotted feathers, young still partially in the down but with wings feathered out, and freshly hatched chicks colored so like the sand about them that when they crouched flat upon it, with outstretched necks and extended wings, they disappeared from view before one's very eyes. Eggs were scattered around in large numbers, but many of them were bad ones which had failed to hatch. Large solemn-looking chicks of the brown booby, still in the down, but apparently heavier than their parents, were sitting about in considerable numbers. There were also numerous breeding groups of northern Bergius' terns, with small chicks and eggs, in addition to the groups previously referred to which contained young big enough to run about actively.

Immediately after landing we observed several noddy terns, *Anous stolidus* (Linnæus). A shot fired at one of these caused thousands upon thousands of birds to take wing. We worked actively until dark, taking photographs and securing specimens of the several species of birds in different plumages, and then returned to the ship heavily ladened with valuable ornithological spoils.

I could not make up my mind to leave the reef without taking additional photographs. The light at the time of our arrival was very weak and it had faded rapidly so that I feared that many of the plates which we had exposed would be failures. Therefore, we stood on and off through the night. The current drifted us some four miles to the northward but we picked up the reef from the masthead at 5.30 the following morning.

On the afternoon of our arrival the birds had been kept in constant motion by the sailors who were running about in search of turtles' eggs, and by other members of our party who were looking in vain for insects or plants.

Our two ornithological collectors remained on board to care for the material obtained the previous day, and I limited the landing party to the Director of the Bureau of Science, one Filipino collector, two sailors, and myself.

With difficulty the sailors were convinced that it was to their interest to sit down and *keep still.* I then got an opportunity to obtain some very interesting photographs. There were a few red-legged boobies on the reef, but so far as I could see they were not breeding. A number of brown boobies had deposited their eggs in hollows in the sand, as there was no nesting material available on the island, except a little

decayed wood laboriously torn from the few tree trunks which had drifted on to reef. One enterprising female had actually dug out enough punk to make a hollow in a log and had deposited her two eggs therein.

Although the number of eggs laid by one bird seemed to be quite uniformly two, in only one instance did I see a brown booby caring for more than one young one. Photographs of the boobies could be taken at any desired distance.

I found it possible to walk directly among the sooty terns. Although they at first flew away from my immediate vicinity they promptly returned again. The nesting groups of the northern Bergius's terns proved much more difficult to approach, but by the exercise of a little care and patience I was able to get quite satisfactory photographs of one such group. I had never previously known that the birds of this species had the power of erecting the black feathers of the head so as to form conspicuous crests. One of the photographs reproduced (Plate V, figure 1) shows clearly that this is the case. Shortly before 10 o'clock a strong breeze sprang up from the southwest. Immediately every sooty tern on the island, except a few of the downy chicks, faced the wind which proved to be the forerunner of a heavy shower. When the rain was almost upon us Doctor Freer fired at a frigate bird. Thousands of terns took wing but instead of circling widely as they had previously done when alarmed, held themselves stationary in the air, hovering for a moment over their eggs and young, but almost immediately dropping upon them again. After the rain began to fall the birds which were incubating eggs refused to leave them until actually pushed away, pecking savagely at the hands of intruders.

I greatly regretted the coming of this shower as I wished to secure more photographs showing the habits of the big booby chicks. When I first landed I saw a number of chicks stretched out flat on the sand with wings extended and heads doubled back under their necks. I thought at first that they were dead but found upon touching them that they were very much alive. I then jumped to the conclusion that they were trying to hide, as did the little terns, but after further observation convinced myself that they were merely sleeping. In each instance when I attempted to turn the camera on them at short range they woke up and hopped awkwardly away.

As there was no sheltering vegetation of any kind the heat upon the reef became intense as soon as the sun got well up. The booby chicks promptly took advantage of the shadows cast by older birds, often coming up from behind and flattening themselves on the sand with their heads stretched under the tails, or even between the legs, of their mothers.

As it was obviously unsafe to remain on the reeef a moment after the sea began to rise, we reluctantly turned our backs on one of the most

extraordinary scenes which I have ever witnessed, waded out to the edge of the shoal, took the boat to the steamer, and sailed for Cavilli Island, where we arrived the next morning shortly after daylight.

Just before we left Maeander Reef three man-of-war birds had suddenly appeared, hurrying in before the on-coming storm, and Doctor Freer had succeeded to our great satisfaction in killing two of them. When discussing our good luck on board the steamer the following evening it was suggested that it only remained to find frigate birds and petrels breeding on Cavilli!

Just as I was going down to breakfast in the morning my son came running to tell me that frigate birds were hovering low over the steamer, and upon ascending to the upper bridge deck I discovered several individuals within easy range. Within the next few moments I shot nine, of which eight were recovered. By this time we could see frigate birds in large numbers flying over Cavilli Island, which like Bankoran Island, is heavily forested. Furthermore, we saw in increasing numbers, birds which we at first took for petrels, and it really began to look as if the wish which we had expressed the night before was to be fulfilled.

Immediately after breakfast we landed in the ship's small boat, having as usual to wade for a long distance over a shoal before reaching the beach. On our way we shot a number of specimens of the above mentioned small petrel-like birds, which proved to be of the genus *Micranous*. No representative of this genus had ever previously been recorded from the Philippines. Comparison with specimens in the United States National Museum shows that this is a species closely allied to *Micranous leucocapillus* (Gould). It is described in this Journal as *Micranous worcesteri* McGregor, sp. nov.[1]

Upon arrival at the beach, Mr. McGregor, the government ornithologist, set off rapidly for a sand spit at the east end of the island where he expected to find *Micranous* breeding, while the rest of us went directly into the forest where I hoped to be able to kill some of the frigate birds which were flying just above the tree tops. To my amazement, I found countless thousands of *Micranous* nesting *in the trees*. A single cartridge, loaded with a small charge of dust shot, brought down seven perfect specimens. Sailors were sent up the trees but found most of the nests empty. We had arrived too late to get eggs in any numbers. An addled egg was, however, obtained, and we also secured several well-grown nestlings which were photographed at short range. The frigate birds had apparently finished nesting but immature birds were present in large numbers.

Red-legged boobies were nesting in the trees, but we did not see a single brown booby on the island.

[1] *This Journal, Sec. D* (1911), 6,

Male frigate birds, *Fregata aquila* (Linnæus), were flying about with their scarlet throat pouches puffed out like children's toy rubber baloons, and a photograph was secured of a fine male which came down wounded and kept its throat pouch partially inflated.

Shortly before noon we returned to our steamer taking with us a splendid series of specimens of the frigate bird and of *Micranous*, and also a number of wood rats which were extraordinarily abundant.

During the lunch hour we ran as near as possible to the Arena Islands of which there are two rising from an extensive shoal. Here we found two frigate birds; also a number of brown boobies nesting on the ground. We decided, however, that it was best to return to Cavilli Island and collect carefully selected specimens of frigate birds in order to complete a series showing fully the immature and adult plumages.

This we were able to do. A wounded bird which fell into the sea near shore served to attract others in large numbers so that we could select our specimens at will. We also obtained a good series of immature red-legged boobies. These birds displayed a great interest in us both when we approached and when we left the island and in several instances attempted to alight upon us or our boat.

Just before dusk as we were leaving for the steamer we witnessed an extraordinary scene. Large numbers of red-legged boobies which had apparently been fishing all day began to return, bringing fish to their nesting mates and to their young. The frigate birds promptly formed a skirmish line and, singly or in pairs, attacked all comers, compelling them to give up their fish. Some of the boobies, possibly sophisticated individuals which had learned wisdom by experience, actually handed their fish over to the frigate birds and so escaped without much drubbing, but less experienced or more obstinate individuals which at first refused to disgorge were vigorously punished until they changed their minds and threw up their fish which were most adroitly caught in the air by their piratical enemies. In one instance two frigate birds set upon a booby, one of them attacking him from above and the other flying below to catch the fish which he dropped, and getting five out of seven. Soon the incoming bobbies began to arrive in flocks and the frigate birds were not able to set upon them all, so that many individuals got through to the island. Once among the trees they were left in peace.

A trip should be made to Cavilli Island earlier in the season when *Micranous* and possibly also the frigate birds will be found mating.

On June 23, 1911, I sailed from Manila with Governor-General Forbes and others on a trip to the Calamianes Islands, Palawan, the Sulu Archipelago, and Mindanao. On the evening of June 28 we left Puerto Princesa for Sibutu and Sitanki, and as the weather was unusually calm decided to go by way of Tub-bataha Reef which I had never previously succeeded in visiting.

Early the following morning we reached that reef finding, near its exterme northern end, a low flat sandy island called Usong. It is some 400 meters long by 150 wide. The sailing directions state that this island has upon it a rock 20 feet high, as well as some trees, but this is not the case. A boat belonging to some turtle hunters was anchored just off the beach and they had erected on shore a small hut thatched with nipa-palm leaves. Doubtless some timid navigator passing the reef at a distance mistook such a house for a rock.

There was no vegetation on the island except a few plants of pursley.[2] There can never have been any trees there as the waves evidently dash clear across it during violent storms.

Brown boobies in enormous numbers were nesting in the sand.

Near the center of the island there was a large colony of black and white boobies, which we at first mistook for red-legged boobies. Presently, however, the Governor-General called my attention to the fact that they were not red-legged. On the contrary their legs, feet, toes, and nails were of a very dark lead color. Indeed they were almost black. Their bills were dull yellow and the bare skin at their bases was of the color of that of the feet and legs. I have since identified these birds as belonging to the species *Sula cyanops* (Sundev.), a species not previously recorded from the Philippines.

There were numerous noddy terns, *Anous stolidus* (Linnaeus), on the island and they were nesting on the ground among the pursely plants. We did not find any of them nesting on the bare sand.

There were also a number of large and interesting groups of northern Bergius's terns. The egg hunters had gathered the terns' eggs into heaps preparatory to carrying them off. I compelled these misguided individuals to leave the birds undisturbed throughout the day, and within a short time the terns had scattered the heaps of eggs over the sand and were incubating as busily and contentedly as if nothing had happened to disturb them.

After gathering numerous typical eggs for the collection of the Bureau of Science, shooting a number of fine specimens of the breeding birds, and taking a series of photographs, we sailed to the south skirting the eastern edge of Tub-bàtaha Reef until the small island on Black Rock Reef hove in sight. Meantime we had passed near a second small sandy island on Tub-bataha Reef. It seemed to be covered with brown boobies, as was the island on Black Rock Reef. We landed on the latter, finding numerous nesting brown boobies and northern Bergius's terns, but nothing else.

[2] *Portulaca oleracea* L.

# ILLUSTRATIONS.

(Photographs by Worcester and Cortez.)

PLATE I.

Brown booby; *Sula leucogastra* (Boddaert).

PLATE II.

FIG. 1. Female brown booby with two large chicks. Maeander Reef.
2. Brown booby with nest and egg. Bankoran Island.

PLATE III.

FIG. 1. Nest and egg of red-legged booby, *Sula piscator* (Linnæus). Bancoran Island.
2. Red-legged boobies nesting. Bankoran Island.

PLATE IV.

FIG. 1. Sooty terns, *Sterna fuscata* (Linnæus). Maeander Reef.
2. Group of sooty terns nesting. Maeander Reef.

PLATE V.

FIG. 1. Northern Bergius's terns, *Sterna boreotis* Bangs, nesting. A sooty tern in the foreground. Maeander Reef.
2. Eggs and young of northen Berguis's tern. Maeander Reef.

PLATE VI.

FIG. 1. Boobies on Usong Island. Tub-bataha Reef.
2. A group of sooty terns, chiefly immature. Boobies in the background.

PLATE VII.

FIG. 1. Young of *Micranous worcesteri* McGregor, sp. nov. in nest.
2. Bankoran Island from the north.

PLATE VIII.

*Sula cyanops* (Sundev.). Usong Island, Tub-bataha Reef.

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# HYBRIDISM AMONG BOOBIES.

By Dean C. Worcester.

On the morning of June 29, 1911, while observing the boobies on Usong Island at the northern end of Tub-bataha Reef, I saw and shot an extraordinarily colored individual which had every appearance of being a hybrid. This led me to walk the length of the island several times, carefully searching among the thousands of nesting birds for other similar individuals. I found two, and I am satisfied that there were no more.

What interested me still more was to find a female *Sula cyanops* mated with a male *Sula leucogastra*. The latter was in full breeding plumage and his sex was conclusively proved by the color of his legs and feet and of the bare skin of his head.

The strangely matched pair had a nest to which they promptly returned whenever I drove them away. It contained no eggs, but this was a lack which was evidently soon to be remedied! There was no possible doubt that the birds were mated, and it seems not improbable that the three hybrid individuals observed, all of which proved to be fully adult, may have been their offspring.

PLATE I.

# ILLUSTRATION.

PLATE I. Portion of colony of nesting boobies on Usong Island showing a female *Sula cyanops* (Sundev.) mated with a male *Sula leucogastra* (Boddaert.)
(Photograph by Worcester.)

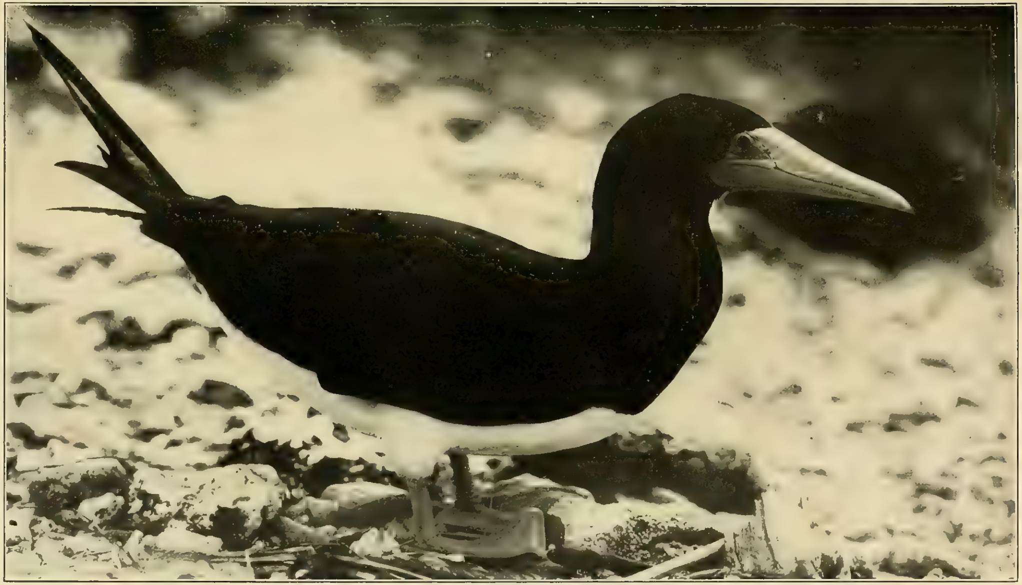

PLATE I.

FIG. 1.

FIG. 2.

PLATE II.

FIG. 1.

FIG. 2.

PLATE III.

FIG. 1.

FIG. 2.

PLATE IV.

FIG. 1.

FIG. 2.

PLATE V.

FIG. 1.

FIG. 2.

PLATE VI.

FIG. 1.

FIG. 2

PLATE VII.

PLATE VIII.

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# RECORD OF A PUFFINUS NEW TO PHILIPPINE WATERS AND DESCRIPTION OF A NEW SPECIES OF MICRANOUS.

By RICHARD C. MCGREGOR.

(*From the Section of Collection of Natural History Specimens, Biological Laboratory. Bureau of Science, Manila, P. I.*)

**Puffinus chlororhynchus** Gould.

A female of this species of shearwater was captured aboard the United States Army transport *Crook*, July 30, 1910, off the Zambales coast, Luzon. Length, 230 millimeters; extent of wings, 960. Legs and feet pale bluish white, brown along the outer side; bill dark horn-brown; iris brown. No. 13172, Bureau of Science collection. Collected by Dean C. Worcester. Dr. Charles W. Richmond of the United States National Museum has examined this specimen and agrees with my identification of it.

**Micranous worcesteri** sp. nov.

*Type*.—No. 7300, adult male, Bureau of Science collection. Collected on Cavilli Island, Sulu Sea, Philippine Islands, September 24, 1910, by Dean C. Worcester, R. C. McGregor, and A. Celestino. Bill black; tarsus and toes dark, reddish brown; nails black. Length, 355 millimeters; wing, 222; tail, 120; exposed culmen, 43; bill from nostril, 31; tarsus, 21; middle toe with claw, 38.

*Specific characters*.—This species is undoubtedly closely related to *M. leucocapillus* Gould, but it differs in having a darker, grayer tail, and somewhat longer toes.

*Immature*.—Large nestlings with rectrices not extending beyond the toes resemble the adult in plumage, but the forehead, crown, and nape are nearly pure white instead of ashy gray.

*Nest and egg*.—The nest of *Micranous worcesteri* consists of a mass of leaves with little or no depression for the egg, and is situated on the branch of a tree. A nest is about 10 centimeters in diameter. The only egg collected by us contained a dead chick and measures 46 by 27

millimeters. Color dull white with a few, large spots of burnt umber about the larger end.

*Remarks.*—As described by Worcester this species is abundant on Cavilli Island during its breeding season. Several of our specimens have been examined by Dr. Charles W. Richmond to whom I am indebted for notes on the various species of the genus. The species is named for Mr. Dean C. Worcester through whose interest and efforts it was discovered.

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# THE SKELETON IN THE FLYING LEMURS, GALEOPTERIDÆ.

By R. W. SHUFELDT.
(*Washington, D. C.*)

(*Concluded.*)

## THE SHOULDER GIRDLE.

Comparative anatomists have observed great differences in the morphology of the shoulder girdle among the various representatives of the Insectivora, not finding this structure alike in any two families of the order. *Cynocephalus* has the two bones composing it, the clavicle and the scapula, remarkably well developed and in full proportions for the size of the animal.

Making the usual articulations with the sternum and the scapula, we find the clavicle to be a large, strong bone. Its extremities are enlarged to support the articulatory facets. The shaft is stout with its continuity of nearly uniform caliber, and presents two curvatures. About two-thirds of its mesial length offers the least apparent curvature, being slightly and uniformly bent so as to present the concavity to the front; the remaining third of the bone makes a very decided curve to arrive at its scapular articulation. This part of its shaft is somewhat anteroposteriorly flattened, or rather compressed, being nearly flat behind and concave in both directions anteriorly. In the normally articulated skeleton, this curvature allows the clavicle to pass over the prominent coracoid process of the scapula, and brings its outer extremity in articulation with the external process of the two apophyses which finish off the upper end of the acromion process of the scapula. In one of the specimens from the Bureau of Science (2) the clavicle has a length of 3.6 centimeters while it is only 3.4 centimeters in the Steere specimen, and 3.5 centimeters in the remaining individual (3). Therefore it averages 3.5 centimeters in length, and is about as long as one of the thirteenth pair of true, or vertebral, ribs of the skeleton to which it belongs.

It is somewhat remarkable that the scapula in some specimens of *Cynocephalus* does not fully ossify; this lack of ossification occurs in the so-called "blade" of the bone (Plate II, figure 5 (1): see explanation

of plates), while in others it is very complete and rather thick (2, 3). Again, the scapula in different individuals is prone to vary in some of its characters, but to no greater extent than we find among a series of human scapulæ chosen from adults of the same sex and race. One of the skeletons sent by McGregor (2) has the scapula thoroughly ossified, quite perfect, and presenting all the characters of the bone as they occur in our subject. It is here seen to be a distinctly triangular bone with all its parts highly developed.

Facing upward and inward, the glenoid cavity is rather extensive; the concavity is pear-shaped in outline, and the small end extends upon the base of the coracoid process. From the glenoid cavity to the inferior angle we have the external or axillary border, which here presents a notable departure from mammalian scapulæ generally in being broad and flat for almost its entire length to the lower point of the bone. This flat border is of uniform width to its termination, that is about 4 millimeters, and appears as if it had been formed by bending that much of the blade of the bone abruptly, at a right angle toward the spine, thus creating a deep "infraspinous fossa," but adding nothing to the ventral aspect of the bone. The vertebral or internal border is not as long as the axillary one, and its margin is only very slightly thickened for its entire length. The two borders make an angle of 30° with each other, and the angle thus formed, or the inferior angle of the scapula, is here rounded off rather than acute; the sizable bit of the apex, evidently formed from the usual independent center of ossification, has not yet united with the blade of the bone.[19] The superior border, extending from the inner base of the coracoid process to the angle which in anthropotomy is known as the "superior angle," is here sharp and uniformly concave throughout its length. The superior angle is about a right angle and is rounded as in most mammalian scapulæ. The superior border is only about one-half as long as the axillary one; the vertebral border stands between the two in this respect. A suprascapular notch hardly exists in the superior border near the coracoid process; indeed, although the greatest concavity of the border here is where it usually occurs, no such break in its continuity is to be distinguished. At its narrowest part the neck of the scapula measures just 1 centimeter, and likewise this is the thickest part of the bone antero-posteriorly, it being about 0.5 centimeter just within the glenoid cavity.

[19] This indicates that the animal was still in a subadult stage when killed. Complete union has taken place in the other two specimens (1 and 3) from which we conclude that they are more advanced in age. In the human species it is not until the sixteenth year that this epiphysis unites with the rest of the scapula at this point.

Smooth and quite level, the subscapular fossa on the venter of the bone exhibits hardly any muscular ridges, the only one of any prominence being a mere indication of such extending from the neck to a mid-point on the vertebral border. Even this may be absent from some specimens.

The coracoid process is represented by a straight, somewhat flattened rod of bone, that may attain a length of nearly 1.5 centimeters. It is extensively attached to a raised base or pedicle at the junction of its inner and middle thirds. This gives rise to a long and a short process, the first assisting in the formation of the articulation for the humerus, and the inner and shorter one for ligamentous attachment. Its longitudinal axis makes an angle with the long axis of the acromion process of about 60°, and an angle of about one-half as many degrees with the plane of the scapular blade. Thus it will be seen that the coracoid is not bifurcated as stated by Flower [20] but simply produced both ways from its base, in the same straight line.

Very conspicuously developed, the spine on the dorsum of the scapula commences superiorly or, perhaps, what may be called externally, beyond the glenoid cavity. Here it supports a large acromion process and a metacromion; this is followed by a somewhat flattened pedicle to the scapular neck, and from there on it becomes a thin lamina of bone which gradually slopes away to a point near the middle of the vertebral border. This osseous partition creates the supraspinous and infraspinous fossæ, which are thus thoroughly defined. The latter is about twice the size of the former, and lengthwise is bounded by the aforesaid spine on the one hand and by the raised axillary, described above, on the other. The scapula makes the usual articulations with the humerus and clavicle, and has attached to it, either by origin or insertion, a number of important muscles and ligaments.

### THE PELVIS.

Beyond a few unimportant individual variations, the pelves (Plate III, figure 8; Plate IV, figure 14, and Plate V, figure 17) of the three specimens of *Cynocephalus* at hand present the same characters for description. On the other hand this part of the skeleton differs widely in its morphology among the Insectivora as a group, being long in some, short in others, while in such genera as *Sorex, Talpa,* and *Chrysochloris* a wide interval separates the pubic bones at the mesial line below, where they usually unite.

When submitted to ordinary maceration in water the two ossa innominata readily part company with the sacrum and with each other. This happened in the case of the Steere specimen here shown in figures 8 and 14. One of the most striking features of the pelvis in *Cynocephalus*

[20] Osteology of the Mammalia, 253.

is its unusual length as compared with its width; the former being about 8.7 centimeters and the latter 4.3 centimeters taken opposite the acetabulæ.

Its articular surface for the sacrum is upon the inner side of the ilium about 1.7 centimeters from the "crest," and covers an area of a little more than 1 centimeter in length. Dorsally, this area projects as an elongated, sharp crest; otherwise it is entirely confined to the surface of the ilium proper and is faintly divided into two facets, a long posterior or dorsal one, and a shorter oval one, parallel to and in close contact with it.

Flower has stated that in "*Galeopithecus*" the symphysis pubis "is long, as in the Carnivora, and becomes ankylosed."[21] He is certainly in error in this statement for in all the specimens before me the symphysis pubis is reduced to the merest contact of the bones, the area being very small, and ankylosis never results. (See figure 14.) As he states, the symphysis is long in most Carnivora, and this can be easily verified by examining the pelvis of any of the Felidæ.

In the articulated skeleton of *Cynocephalus* the preacetabular portions of the ilia are nearly parallel to each other and lie in a subtransverse plane that makes but a slight angle with the longitudinal axis of the lumbar and sacral vertebræ. The anterior presacral portions of the ilia are directed upward, forward, and outward; the free extremities, which are slightly enlarged and rounded, are about opposite the neural spines of the vertebræ. Thus it will be observed that all the preacetabular portion of the pelvis affords but very slight protection to the contained abdominal viscera; it does afford protection to some extent laterally, and in conjunction with the sacrum and leading caudal vertebræ, to a greater extent dorsally.

It remains to say of the preacetabular part of an ilium that it is sigmoid in form, and for the most part subcylindrical, although exhibiting slight longitudinal flatness dorsally, mesially, and externally. This rod-like part of the ilium gradually expands as it comes to the acetabulum which it assists in forming. The latter is large, being over 1 centimeter in diameter, and presents all the usual mammalian characters. Its cotyloid notch is wide and rather deep; the cotyloid articular ring is well developed; while the bone at the bottom of the cavity is often very thin and always translucent. As usual, it is formed by the three pelvic bones, the ilium, the ischium, and the pubes, the sutures among which have become entirely obliterated within the cotyloid cavity. In fact the only sutural line that persists throughout the life of the individual among any of the three pelvic bones is the one between the rami of the ischium and pubes. It is very distinct in all specimens at hand, and probably is invariably present. (Figure 14.)

[21] Osteology of the Mammalia, 320.

The postacetabular portion of the pelvis is triangular in outline, the acetabulum occupying one angle, the symphysis pubis another, and the remaining one being at the tuberosity of the ischium, the last two being rounded off. Upon its mesial aspect this part of the bone is uniformly and moderately concave throughout, and entirely unmarked by elevations or depressions. It encloses the very large, oval, obturator foramen, the larger end of which is formed by the ischiopubic rami, where its margin is sharp and clean cut, it being thicker and more rounded for the remainder of the curve of this vacuity.

Externally the surface of the postacetabular part of the pelvis is likewise smooth, with its convexity corresponding to the concavity of the mesial aspect. But one muscular line marks it, and that the usual one, halfway between the obturator foramen and the tuberosity of the ischium, indicating the limitations of the areas where arise certain important muscles of the thigh, or more exactly, of the posterior femoral and adjacent regions.

The external borders bounding this postacetabular portion of the pelvis are rounded, smooth, and continuous for the pectineal line, continuous and slightly thickened for the ramal line, and considerably thickened where formed dorsally by the ischium. The ischium presents two prominent tubercles just without the rami of the cotyloid cavity. They are separated by a shallow valley or notch, and the anterior one has generally been designated as the "spine of the ischium," at least, it has been so-called in the human skeleton, where it affords surface for the origin of the gemellus superior muscle, the gemellus inferior arising from the other tuberosity. These muscles among the lower mammalia are generally known as the gemellus anterior and gemellus posterior, owing to the direction of the longitudinal axis of the body.

### THE SKELETON OF THE PECTORAL LIMB.

Both pairs of limbs in *Cynocephalus* are fully and powerfully developed, and they present many points of considerable interest. In writing upon the subject of "the adaptive changes which take place in the segments of the limbs proper in various animals," Flower [22] has said:

> In what may be considered the first stage of modification each segment of the limb is simply bent upon the one above it. The proximal segments (humerus and femur) remain unchanged in position, the dorsal surface still looking upwards, and the ventral surface downwards, the middle segment is bent downwards, so that its ventral surface faces inwards and its dorsal surface outwards; and the joints between these segments (elbow and knee) form prominent angular projections.
>
> The third segment being bent to a greater or less degree, in the opposite direction to the middle one, retains much of its primitive position, the dorsal surface being directed upwards and the ends of the digits pointing outwards. The relations of the pre-axial and post-axial borders of the limb are unchanged. No

[22] Osteology of the Mammalia (1885), 365, 366.

mammal habitually carries its limbs in this position, although the climbing *Galeopithecus* and the Sloths are not far from it. It is, however, very nearly the normal position of some Reptiles, especially the Tortoises, although it is ill adapted for anything but a very slow and clumsy mode of progression.

In *Cynocephalus* the humerus makes the usual articulations with the scapula proximally, and the radius and ulna distally, that are seen among mammals generally. These articulations are in all cases extensive and the joints very perfect anatomically.

The left humerus of the colugo (figure 15) offers the following points for examination, some of which are better seen in the right humerus (figure 16) from the same skeleton, this being due to the different positions in which the bones were photographed. Its characters, including its length and to some extent its size, vary somewhat in various individuals. It is considerably shorter than the ulna or the radius; in man it is the longest bone of the arm.

Viewed in its entirety, upon either its direct inner or outer aspect, the humerus is seen to possess for its continuity the true "sigmoid curve." This curve starts at the head and terminates with the trochlear extremity. Ignoring the prominent ridges its shaft is for the most part subcylindrical in form, the principal departure being at the distal end which is expanded to support the trochleæ for the bones of the antibrachium. It is uniformly smooth, and pierced by an oblique, nutrient foramen situated about 2 centimeters distad of the articular part of the head, on the posterior aspect.

The very conspicuously elevated deltoid ridge with its thickened edge extends down the shaft, on its anterior aspect, for about one-third of its length. It commences at the head and slopes away rather abruptly distally. Its nearly straight free margin is almost parallel to the shaft's long axis, its sides being smooth. On the other hand the supinator ridge is low, sharp, and thin, extending from the external condyle almost to a middle point of the shaft, following accurately the lower sigmoidal curvature of the latter, where it is gradually lost.

Among mammals we rarely meet with the humerus possessing a more perfect head than it does in *Cynocephalus,* in which genus it is almost a complete and entirely smooth hemisphere. For the most part its articular surface is distinctly differentiated by its circular limiting line and surrounding shallow groove or neck, the major part of which is seen on posterior view. It reminds one of the humeral head of anthropotomy and surmounts the shaft in a very similar manner (figure 15). Upon either side of it the greater and lesser tuberosities are well developed, the comparatively deep bicipital groove passing the latter down the shaft and the side of the deltoid ridge.

At the distal extremity of the bone, posteriorly, the olecranon fossa is very deep and markedly defined. Its osseous base is thin, and may

be perforated by a minute foramen. The internal and external condyles are large, and pitted for the origin of certain muscles upon either side. Above the internal condyle, anteriorly, there exists a delicate span of bone of no great length. It passes, as a gently curved arch from the condyle, obliquely toward the center of the shaft in a proximal direction forming the supracondyloid foramen (figure 15), which gives passage and protection to the median nerve and brachial artery. Where high division of the brachial occurs, the nerve only, as a rule, passes under it, but may be accompanied by the ulnar-interosseous artery.

The distal points of the trochlea and capitellum lie in the same horizontal plane to which the axis of the shaft is perpendicular. Each constitutes a prominent tuberosity separated distally by a well-marked valley. Both in front and behind they rise to the same transverse line on the shaft, ceasing at the distal boundary of the olecranon fossa posteriorly, and at the rather shallow depression intended for the ulna anteriorly. The smaller tuberosity is flat upon its internal aspect, while the capitellum for the radius is fully double the size with a roundly convex articular surface. The average extreme length of the humerus is about 10.2 centimeters.

Judging from the material at hand it would appear that when the bones of the arm are normally articulated they admit of extreme flexion to a far greater degree than they do of extreme extension, that is, extension to the extent of bringing the long axis of the shaft of the humerus and the ulna into one and the same straight line.

The radius is a very strong and nearly straight bone with enlarged extremities and subcylindrical smooth shaft. It has an average extreme length of 12.2 centimeters, or two centimeters greater than the humerus. (Plate III, figure 9.) At its proximal end, the tuberosity for the insertion of the tendon of the biceps, is represented by a short longitudinal crest, terminating in a groove near which we usually discover the opening of a small nutrient foramen. Above the tuberosity the bone is somewhat constricted to form the neck of the radius and the latter is surmounted by the head of the bone. The head is large, oval in outline, and at its summit exists the rather deep concavity for articulation with the capitellum of the humerus, while its marginal articulatory surface for the ulna is about 2 millimeters deep. The outer lower third, or more, of the shaft is flattened, forming a surface to which the distal fourth of the ulna is firmly attached by ligament. Anteriorly, on its expanded part at this extremity, we note the five conspicuous longitudinal grooves intended for the passage of the extensor tendons as they go to the hand. A sharp, peg-like, styloid process projects forward at the outer side of the bone, but does not extend beyond the border over which the extensor tendons pass. Internal to this process is a deep, elliptical, transverse facet for articulation with the first row of bones of the wrist

or carpus. The interosseous space existing between the articulated ulna and radius is long and narrow. From a study of the various articulations of the antibrachium it would appear that during life the power of pronation and supination must be somewhat limited.

A very considerable amount of atrophy marks the development of the ulna of *Cynocephalus*. To some slight extend this involves the head of the bone, but is far more evident in the shaft. (Plate III, figure 9.)

On the whole the ulna is very straight from one extremity to the other, straighter distally than represented in figure 9, where some curvature is shown due to long maceration and subsequent drying. It has an average length of 12.1 centimeters, or is practically of the same length as its companion in the antibrachium; it holds a postaxial position with respect to the latter in the normally articulated skeleton. Among other mammals, where the ulna is fully developed, it is a much longer bone than the radius, due principally to its extension at the elbow. This is the case in man, in the Felidæ, and in many other mammals.

In the subject here under consideration the shaft of the ulna below the head is considerably compressed from side to side and longitudinally grooved for some little distance on its radial aspect, thus giving rise to a sharp margin for the attachment of the interosseous membrane. From its coronoid process to its distal apex the shaft contracts very gradually and uniformly, and where the lateral flattening ceases it becomes more or less compressed in the opposite direction, a condition which continues to its distal end. On its outer surface this flatness is continuous from one end of the bone to the other. In human osteology this outer surface is described as the posterior surface of the ulna.[23]

Distally, the ulna is carried finally to a very sharp apex, or point, which in the articulated skeleton is found just above the styloid process of the radius. This point, together with the lower fourth of the bone, is closely applied to the shaft of the radius and is held there by a firm ligamentous attachment. That it ever actually ankyloses with the radius is very much to be doubted, as ordinary maceration is quite sufficient to separate the two completely.

Proximally, the greater sigmoid cavity is circularly concave and not very wide, although withal of good size; it is overarched by the olecranon, which is here concave on its summit, uniformly thick from before, backward, and pretty well fills the deep olecranon fossa of the humerus when the limb is fully extended. There is not the slightest evidence of any longitudinal division of the greater sigmoid cavity by a raised central ridge as in man and other mammals.

Both the lesser sigmoid cavity and the coronoid process are well developed, the former being but very slightly concaved with its limiting margin sharp and circular in outline. On the radial aspect of the head

[23] Gray's Anatomy (1870), fig. 158.

a deep notch marks the boundary between the two sigmoid cavities, while on the opposite side the limiting border is continuous and distinctly circular in outline (figure 9). It is unnecessary to add that such an ulna as *Cynocephalus* possesses takes no part in the carpal articulation.

The bones of the arm and forearm vary among the Insectivora to a very marked degree; as, for example, among the hedgehogs, moles, and shrews; and it is said that the ulna in *Macroscelides* and *Petrodromus* is atrophied distally as in the colugo, but whether in these animals it coössifies with the radius at that end may be open to question.

According to Flower:

> Among the insectivora, the scaphoid and lunar (in the carpus) coalesce in *Galeopithecus*, *Tupaia*, *Centetes*, *Solenodon*, *Erinaceus*, and *Gymnura*, but in most of the other forms these bones are distinct. A distinct os centrale is found in all except *Galeopithecus*, *Potamogale*, *Chrysochloris*, and *Sorex*.[24]

A very careful microscopical examination of two wrists, or carpi, in two different specimens of the material at hand, proves beyond all question that this statement, in so far as *Cynocephalus* is concerned, is quite incorrect. All of the eight usual bones of the carpus are to be found in this animal. They are especially well developed in the manus of Steere's specimen, the one from the right pectoral limb having been very carefully examined by me under a high-power lens. There are four bones in the proximal, and an equal number in the distal row.

Commencing at the inner end of the proximal row (ulnar side) we find the pisiform to be represented by a rather large, elongate ossicle that has a facet upon its mesial aspect merging with another distally, the first articulating with the cuneiform, and the latter with the unciform, as in the Felidæ and probably other mammals. Cuneiform, one-third larger than pisiform, is of an irregular cuboidal shape, with a small facet for pisiform, and a larger one for unciform and semilunar, the latter being much concaved.

The semilunar is larger than any three of the other carpal bones taken together, and is the only one of the wrist that articulates with the former. This it does with its large semi-ellipsoidal facet on its proximal aspect, intended for the articulation at the distal end of the radius. Its outer extremity also has a rather large, nearly circular, facet with which the scaphoid articulates. Distally, the bone presents a raised, ridgelike, longitudinal articulation for the trapezium; this is separated by a deep groove from a larger, central, likewise longitudinal, raised facet which articulates with trapezoid and os magnum. More internally it offers a small articular surface to the unciform. Thus it will be seen that the semilunar articulates with no fewer than seven bones, viz: radius, cuneiform.

[24] Osteology of the Mammalia (1885), 289. This authority's description of the hand in the insectivores will hardly apply with accuracy to the colugo which is unusually large.

unciform, magnum, trapezoid, trapezium, and scaphoid. Scaphoid is a small compressed bone, but is larger than pisiform; it has but a single articular facet covering its entire mesial aspect that articulates with a similar facet on semilunar. It is connected with the trapezium by ligament only.[25]

Trapezium of the distal row is only exceeded in size by the unciform. It is of an irregular cuboidal shape, with articular facets for the proximal end of pollex metacarpal, trapezoid, and lunar. Above it, attached by ligament only, we find the scaphoid, while mesially it presents a small facet to the proximal end of index metacarpus.

Having very nearly the same form and size, either being parallelepipedal with respect to the former, the trapezoid and os magnum articulate with each other and both with semilunar. Trapezoid also articulates with the metacarpus of index digit, as os magnum does with the same bone of the middle finger.

Unciform is a cube of irregular shape, the last carpal in the distal row on the ulnar side, that articulates with lunar, cuneiform, and the metacarpus of minimus digit, and the inner side of the base of the metacarpus of the fourth phalanx. Its palmar process is but feebly developed.

The manus of *Cynocephalus* is large in proportion to the size of the animal, and exhibits in its skeletal morphology the chief uses to which it is put, that is, being fitted to serve the purposes of climbing rather than of prehension. It is especially long and rather narrow, being armed distally with very efficient and powerfully hooked claws. It is a pentadactyl member with a short pollex and four elongated digits. All the phalanges composing these digits present the usual characters seen among ordinary small mammals. Their shafts are very nearly straight and quite cylindrical, while their distal extremities, or heads, support the usual double trochleæ for articulation with the phalanx next beyond them in each instance. The base of each of these long bones is larger than its head and also presents an articular facet, which is oval and concave to receive the head of the phalanx next behind it. The ungual, or distal, joints are entirely different and will be described further on. The metacarpus consists of five bones; distally they articulate with the five proximal phalanges of the digits and at their other ends with the carpus in a manner already pointed out. Pollex metacarpal is very considerably shorter than any of the others; index and minimus metacarpals

[25] In describing this bone as the scaphoid, the fact is known to me that among rodents there are many wherein the scaphoid and lunar unite to form a single bone; and further that a special ossicle, which has been described as occurring on the radical side of the wrist, is of very considerable size in *Castor*. It has also been said that in the beaver the scaphoid and lunar fuse to form one bone. Notwithstanding these statements it is contended here that the scaphoid is present in *Cynocephalus*, though embryology may disprove it, and two centers of ossification may be shown to exist in the bone here described as semilunar.

come next in length and nearly equal each other in this respect. Medius and annulus metacarpals are also of equal length and larger than any of the other bones of this part of the hand. Pollex metacarpal is the stoutest of them all and is about 1.6 centimeters long; minimus is also stout and has a length of about 2.8 centimeters, while that of index is 5 millimeters shorter. The shafts of the middle and ring, or the medius and annulus, metacarpals are rather more slender, and each is nearly 3 centimeters long. These metacarpal bones are slightly curved palmad and like the phalanges, nearly parallel and very close to each other when the member is at rest. Pollex has one short (1.5 centimeters), stout phalangeal joint and an ungual joint; all the other digits have three each including the ungual joints. Index is the shortest finger, minimus next, with medius and annulus of about equal length. Not including the terminal joint, annulus has a length of about 4 centimeters.

The ungual joints are all very much of the same form and size; the largest being on pollex, index, and the next two digits, the smallest on the little finger. Any one of them is very deep from dorsal to palmar border, the latter being slightly concave, and the former powerfully convex and a little jagged distally. From side to side one of these thoroughly ossified joints is uniformly compressed to extreme thinness, while its proximal border is somewhat thickened for the articular facet and for tendinal insertions. At the postero-dorsal angle there is a very small, concave, circular process for the insertion of the extensor tendon; palmad to this is a large concave facet divided by a median longitudinal ridge. This concavity is twice as deep as it is wide, and its surrounding border is raised above the general surface. Palmad to this again, at the postero-palmar angle, there is another very small process for the insertion of the flexor tendon, while above this, beneath the lower border of the mid-articular facet, are two minute foramina, side by side in the transverse line. They lead into the bone and appear to be nutrient foramina.

The horny theca, fitting as a claw over one of these ungual joints, is also powerfully compressed from side to side, and in form, with its very sharp apex, resembles upon lateral view the upper bill of one of the smaller typical falcons.

On the palmar aspect, beneath the articular joints of the metacarpals and phalangeal bones, we observe in the case of each digit a pair of sesamoids. These have the form of small compressed ellipsoids, the largest ones being in the proximal tier of bones, whereas in the case of the smaller pairs beyond, they are placed side by side in the transverse line.

Distally, the sesamoids are very minute and may be absent in the index digit, between its first and second phalanx. They do not occur, apparently, beneath the ungual joints at all. These sesamoids occur in the hands and feet of other mammals, as certain carnivora, and even in the tendons running to the toes on the plantar aspect of the foot in man.

THE SKELETON OF THE PELVIC LIMB.

Proportionately, the pelvic limb of *Cynocephalus* is not as powerfully developed as is the pectoral limb, though there seem to be exceptions to this general rule. In Steere's specimen, for example, the long bones of the posterior limbs are fully as well developed as are the corresponding ones in the anterior extremities. However, pes always seems to be weaker and somewhat smaller than manus, and this is also evidenced in the skeleton of these parts.

In the matter of proportions there are very marked differences in the pelvic limbs of the three skeletons at hand. These differences may be due to the fact that they came from different species, or if from the same species, it may be due to differences in age or even sex. In any event the Steere specimen was a much bigger animal than either of the McGregor specimens, and one of the latter (3) is larger than the other (2), though the characters throughout agree.

Two of the femora, selected as examples, show how marked these differences are; for instance, the right femur of the Steere skeleton has an extreme length of 12.3 centimeters, as compared with the extreme length of the femur in the smaller of the two individuals from the Bureau of Science, which is only 11.1 centimeters. Then in the matter of actual size the two bones are also in proportion to this difference in length, the shaft of the femur in the first case being fully one-third larger than in the second case.

The description of the pelvic limb here given is from the right side of the skeleton in Steere's specimen, with occasional reference to the other two individuals.

The femur (Plate II, figure 6), possesses a stout, straight, cylindrical shaft, which is so smooth that even linea aspera is scarcely indicated upon it. The proximal extremity of the bone presents an elegant, smooth, hemispherical head, in fact so globular is it that it approaches the sphere. This head is marked by no pit for the ligamentum teres; its boundary is sharply defined in front; less so behind, where the articular surface encroaches slightly upon the summit of the shaft of the bone. The axis of the head and neck makes an obtuse angle with the axis of the shaft, thus bringing the head above the latter's summit. Conspicuous and rough, the great trochanter curves slightly to the front, thus making the neck of the bone very distinct behind it and the caput femuris. Minute nutrient foramina may occur in this locality. On the postero-external aspect of the great trochanter there is a well-marked pit, the so-called trochanteric fossa, within which certain muscles are inserted.

Situated internally and at the same time posteriorly, and about 1 centimeter below the head, there arises the lesser trochanter, sometimes called the tibial trochanter. It is bluntly triangular in form, and arises from a substantial base. On the opposite side of the shaft, that is, on its

external border, and rather lower, there is still another and smaller process, which is the third trochanter. Between these two projections on the posterior aspect of the bone, the shaft is very smooth and particularly flat. No spiral line joins the greater and lesser trochanters on the anterior surface of the bone, while posteriorly, the trochanteric line is very feebly pronounced in the corresponding locality. Both these lines, or intertrochanteric ridges, are very noticeable in the femora of many other mammals, man included.

At the distal end of the shaft the two condyles are strong and thick. They are almost exactly of the same size and neither one is lower on the shaft than the other, as is sometimes the case among mammals where the inner condyle is the lower of the two.

The smooth, convex, articular surfaces seen posteriorly on these condyles are practically of exactly the same size, and they terminate in the same transverse planes, both above and below. Between them is a deep, sharply defined, intercondyloid notch, that terminates abruptly at the lowest plane of the bone and superiorly in a similar manner on a flat surface named in anthropotomy the popliteal space. Again, either the internal or external condyle exhibits upon its outer surface a distinct pit, or depression, wherein certain muscles arise or are inserted. One is about as well marked as the other, as are the tuberosities that occur, one in each case, above them. The one on the outer condyle is the outer tuberosity, and the other the inner tuberosity. Anteriorly, the intercondyloid space is of a nearly quadrilateral outline; it is smooth, slightly narrower above than below, gently concave from side to side, and roundly convex in the longitudinal direction with respect to the axis of the shaft. This surface is shown in figure 6.

The patella is poorly developed in *Cynocephalus*. It may, or may not, be completely performed in bone, and there is reason to believe that in young specimens it will always be found in cartilage or at the best in very elementary osseous tissue. When in bone it is not large, though it extends from a point opposite the center of one condyle to a point opposite the center of the other, being parallelogramatic in outline, with the long sides transverse. Anteriorly, the patella is convex from above, downward, and correspondingly concave posteriorly. The tendon in which this sesamoid is embedded, the quadriceps extensor, is very tough and strong and is inserted on the free anterior border of the head of the tibia.

The tibia is the longest bone in the skeleton of this animal; it is, however, by no means the stoutest, being exceeded in this respect by both the humerus and the femur. Proximally the tibia has a shaft the caliber of which about equals that of the femoral shaft at the junction of its upper and middle thirds, but as we pass to the distal end this caliber gradually diminishes until just before arriving at the lower end of the

bone. The shaft, likewise, exhibits a curvature from one extremity to the other, the greatest amount being at its middle; the entire convexity is on the outer side. The shaft of the tibia in most mammals is triangular in section, but in *Cynocephalus* it is quite quadrilateral, especially where its caliber is at its minimum. A shallow longitudinal groove marks its outer aspect, being best seen along the middle third; otherwise the bone, or rather its continuity, is devoid of any particular characters.

The proximal end, or what is known as the head of the bone, is expanded and nearly as big as the distal end of the femur. This expansion gives rise to two lateral eminences, the tuberosities of the tibia. They support superiorly the two smooth concavities with which the condyles of the femur articulate in life. In extent they are of about equal size, and between them toward the back of the bone is a low, pointed process, the spinous process of the tibia. A slight notch occurs in the posterior border bounding the tibial head which has received the name of the popliteal notch, and to it the posterior crucial ligament is attached. On the outer side of the head there occurs a flat, subcircular, articular facet intended for the head of the fibula. It is of no great size. Posteriorly, the boundary of the head somewhat overhangs or extends beyond the shaft, which is here broad, flat, and smooth.

The enlarged distal end of the tibia is not more than one-half the bulk of the proximal extremity, and it has a form to fulfill a variety of purposes. Chief among these are its articulation with one of the bones of the metacarpus, its articulation with the fibula, for the passage of tendons of certain muscles, and for ligamentous attachment. At its inner side it is prolonged distally into a prominent process which is the internal malleolus. Just above this there is a deep, oblique groove, its lower opening being in front. In life this groove gives passage to the tendons of the flexer longus digitorum and the tibialis posticus muscles. There is a small, rough, inconspicuous facet on the outer side of this distal end of the bone with which the lower end of the fibula articulates. The extreme inferior surface of this extremity is given over entirely to a broad, spindle-shaped, articulate concavity which in life articulates with the astragalus; internally this is carried slightly up the shaft, or at least upon the back of this end of the bone. In front this extremity is convex from side to side and very smooth; over it in life glide the extensor tendons.

The fibula is very nearly as long as the tibia, being exceeded only by the internal malleolus of the latter. On the whole it is the most slender long-bone in the skeleton and, for its length, the straightest. Some specimens have the proximal moiety reduced to extreme slenderness while the head of the bone at that end, which makes a feeble articulation with the tibia, is always reduced to a mere semiellipsoidal nib, only a few millimeters long, flattened on its inner articular aspect, and convex


PLATE III.

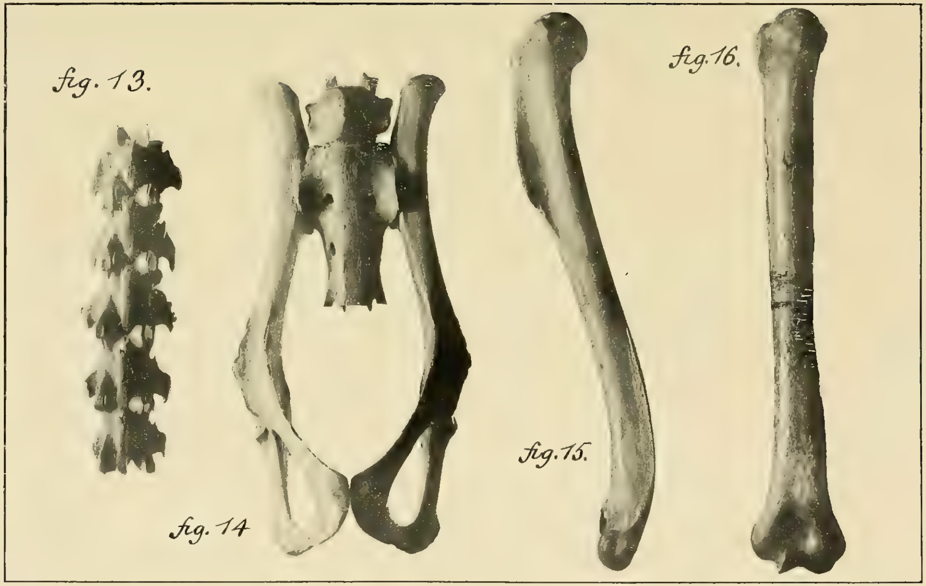


PLATE IV.

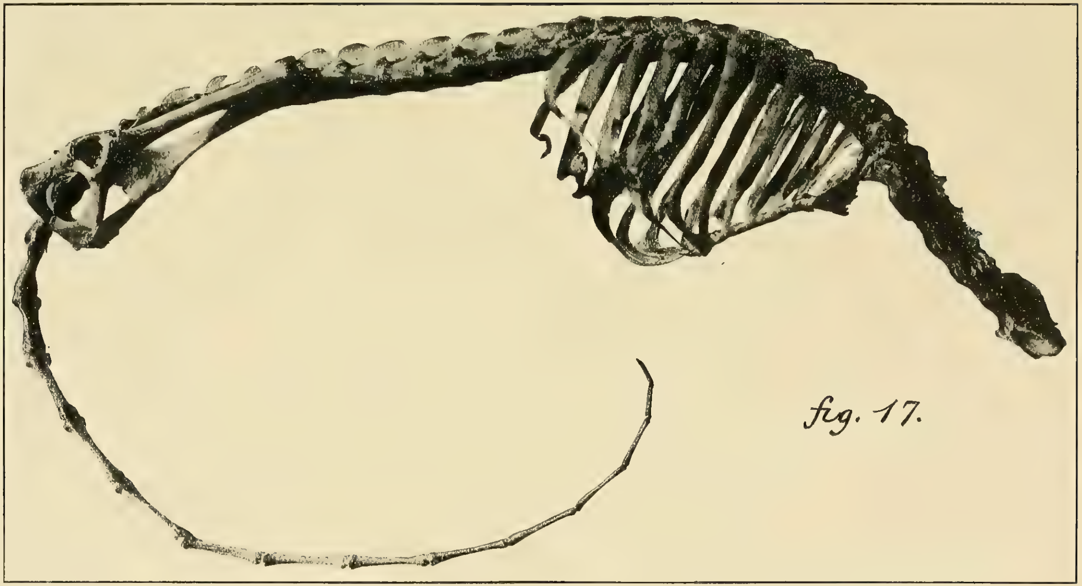


PLATE V.

on its outer. The shaft is smooth, compressed from within, outward, and very gradually increases in caliber toward its malleolar extremity. In one specimen (3) this bone is deeply and longitudinally grooved for the entire upper one-third of its tibial aspect.

Bulbous in shape, its distal end forms the external malleolus, being obliquely truncate from above, downward, and outward; the inner surface is given over to the facets for articulation with the tibia and the astragalus of the foot. Above this is a distinct little process for ligamentous attachment. There is another, but larger, tubercle on its outer aspect. Ligaments of the ankle are also attached at a few other points; in fact, the most important function of this bone in *Cynocephalus* is to assist in completing this very essential joint.

Pes contains the same number of metatarsals as manus contains metacarpals, and the toes the same number of phalanges as we find in the hand; that is, three joints in all the toes with but two in hallux.

The study of the foot of *Cynocephalus* is wonderfully interesting. Owing to the unusual way the member has been used and ontogenetically evolved, it has the appearance, on first sight, of having been dislocated. The articulatory part of the astragalus which articulates with the tibia, and to some extent the bone itself, has rotated inward and to a degree forward, so that the longitudinal axis of this long and narrow foot makes a varying angle with the continuity of the shafts of the bones of the leg. This angle in the vertical plane may range all the way from 120° through a right angle to an acute one of 70°, according to the manner in which the animal holds its foot. The member possesses also a certain amount of motion either backward and forward, when the limb is held away from the body, or inward and outward, when it is brought near the latter and the effort is made to move the foot in those directions.

Flower [26] states, and it is true, that "The bones of the tarsus of mammals present fewer diversities of number and arrangement than those of the carpus." *Cynocephalus* offers no exception to this rule.

There are seven bones in the tarsus of the colugo, namely the astragalus, the os calcis or calcaneum, the scaphoid or navicular, the three cuneiforms (internal, middle, and external), and the cuboid. This enumeration does not take into consideration the presence of several important sesamoids which will be noticed farther on.

The astragalus of all the tarsal bones is next in size to the os calcis, the latter being the largest bone of the foot. In man this bone receives

[26] Osteology of the Mammalia, 340. Many works have been examined in this connection, and the literature of the subject is very extensive, but it would appear that no author as yet has produced sufficient evidence to warrant any radical change in the nomenclature of the tarsal bones, or to set aside their homologies as they have long been given in standard treatises on anatomy.

the weight of the body in standing and walking, transmitted to it from the tibia, and to a very slight degree the fibula. Quadrupeds have this weight variously divided, while in *Cynocephalus* it appears that this tibio-tarsal joint sees its chief use as an enarthrodial articulation. Usually the very irregularly-shaped astragalus is described as having a head, a neck, and a body, and such divisions are easily made out. When duly articulated, the head projects to the front in line with the scaphoid, the cuneiform bones, and the first and second toes. Anteriorly the head has a large, smooth, convex facet which articulates with a concavity in the scaphoid and a surface on the antero-superior aspect of the os calcis.[27] The latter encroaches upon the surface of the neck beneath. The neck is somewhat compressed from above downward (here really from side to side), and is wider in the opposite direction. The entire upper part of the body is occupied by an elegant, smooth, convex facet for articulation with the two bones of the leg. This articular surface is carried over upon the sides of the astragalus, and here the malleoli of the aforesaid bones articulate, as is the case with nearly all mammals. Fibula gets the smaller share, a little less than one-half of this articulation. Posteriorly and beneath we note a well-marked groove, which in life gives passage to the tendon of the flexor longus hallucis muscle. On the sides there are pits for the attachment of ligaments. At the center of the bone, on the side next to the os calcis in articulation, there is an irregular concavity; this is on the neck, while posterior to it on the body there is an elliptical facet for a similar one on the calcaneum. No muscle either arises from, or is inserted upon, the astragalus, and as pointed out above the astragalus articulates with four bones: tibia, fibula, calcaneum, and scaphoid.

The os calcis or calcaneum, is longer, narrower, and larger than the astragalus; the latter projects just a trifle more to the front, while the former exceeds it in length behind. Altogether the bone is very irregular in form and has the tendons of a number of muscles and ligaments attached to it, or arising from it. Os calcis is the tarsal that forms the skeletal part of the heel and here we find this posterior extension to be a distinct semi-ellipsoidal projection, subvertically placed upon the body of the bone. This is generally called its tuberosity, and upon it is inserted the tendo Achillis. Beyond it, the body of the bone is somewhat constricted and compressed from side to side. Mesially, it throws out a conspicuous triangular process, the upper side of which articulates with the under side of the neck of the astragalus. A similar, rather smaller,

[27] In assigning directions, and the directions in which surfaces look or face, for the sake of convenience, it is assumed that the animal stands on the ground as do ordinary quadrupeds, otherwise it would be very difficult to appreciate the relations of the tarsus to the rest of the skeleton, and the most unusual position in which the foot is held with respect to the surface upon which the animal is traveling.

apophysis, occurs on the outer aspect of the bone just posterior to the cuboidal articulation; this is intended for muscular insertion.

Anteriorly, the face of the os calcis is entirely given over to a concavo-convex articular facet for the cuboid, which presents a peculiarity, in that it is conically hollowed on the planter border; into this fits a pea-like articular process on the cuboid. On the under, or planter, side of this the two bones are firmly lashed together by a broad tough ligament. There would appear to be some special cause for the development of a joint such as this, but the cause is not apparent. Internal to the cuboid articulation there is a small facet for the scaphoid. When the two tarsal bones thus far described are articulated, and we view them from what is really the outer side, we note that the plantar aspect of the neck of the astragalus is oblique and arches over a similar groove on the calcaneum, the two forming a foraminal passage through which we can look. In the recent state this is filled up by the calcaneo-astragaloid interosseous ligament, and is present in nearly all ordinary mammals.

The cuboid in *Cynocephalus* is really more or less cuboidal in form; its posterior articular face has already been described. It is also articular in front where its slightly concave surface is divided by a ridge into two, for the fourth and fifth metatarsals. There is a strong oblique groove on its plantar surface, and this lodges the tendon of the peroneus longus muscle. On its mesial aspect the cuboid makes an extensive articulation with the scaphoid, and also the external cuneiform. Thus it articulates with four bones: calcaneum, scaphoid, and the fourth and fifth metatarsals.

Os naviculare, or scaphoid, is rather larger than the cuboid and its posterior articulation is somewhat remarkable, for it not only articulates with the head of the astragalus, but on its plantar aspect on the margin of this articulation, it sends back a distinct process the side of which articulates with the os calcis, and upon which the plantar surface of a part of the head of the astragalus rests. This process has a notch on its outer side. Anteriorly, it has facets to articulate with the three cuneiform bones. These are all more or less cuboidal in form, differing a little in the matter of size, and each articulates anteriorly with the base of a metatarsal. The internal cuneiform is the largest and joins the hallux metatarsal; it extends farthest to the front; the middle one is the smallest, and the external one is between the two in point of size.

The three middle metatarsals very closely resemble the corresponding bones in the hand, while in the foot a peculiarity is seen in hallux metatarsal in that it has a conspicuous, rounded process erected on the dorsal aspect of its extreme distal end. The articular surface in front is carried upon this, affording the joint next beyond an unusual amount of backward play in the vertical plane.

The metatarsal of the little toe is almost as stout as, and considerably longer than, hallux metatarsal, and as in many other mammals it developes a process proximad that projects from the side of the foot. This is the tuberosity of the fifth metatarsal; in man and probably in many other mammals the peroneus brevis muscle is attached to it.

The distal phalanges as well as the greatly compressed ungual joints, closely resemble those of manus and consequently require no special description.

At the side of the foot, a short distance back of the hallux metatarsal and apparently encased in the lateral ligaments in that locality, there is a large, flat, quadrilateral sesamoid. It is on the tibial side of the tarsus and rests, flatwise, on the scaphoid and internal cuneiform bones. Baur took this to be the rudimentary tarsale tibiale in which he was doubtless mistaken, as it is sesamoidal in all its characters.[28]

It would appear that no special name has as yet been bestowed upon this bone, so it might conveniently be known as the tarsal sesamoid.

There are other sesamoids in the sole of this foot, and they agree in all particulars with the corresponding ones in the hand. We see them, proximad, just within the tarsophalangeal articulations, a pair back of each joint, and very much smaller pairs in the row of joints beyond. Occasionally specimens are found having a few very small sesamoids in the sole of pes, and in the partly cleaned skeleton the palmar surface of the process projecting backward from the scaphoid may easily be mistaken for one, as it is exposed there and has the same elliptical form.

No tendon of any of the muscles in *Cynocephalus* has been found to ossify, nor have there been, beyond the rings of the trachea, any other ossifications met with in this animal.

So much then for the osteolgy of *Cynocephalus*, the caguan, the aberrant insectivore of certain islands of the Indian Archipelago, which we know is certainly no lemur.

THE HYOID ARCHES AND THE LARYNX.

As stated above the specimens here described lacked the hyoid arches and the trachea. This I communicated to Mr. McGregor by letter and in due time received the following reply from him.

I have, unanswered, your letters of October last and of January of this year [1909.] I am glad to know that you have a paper on *Galeopithecus* roughed out and I will hope to be on hand to see it copied and to read the proof for it. I regret that the specimens sent you were incomplete. They were prepared in the field by my assistant at a time when we had a great press of other work and you know what that is in a hot climate. I am fortunate in having on hand a pickled specimen of the lemur from Basilan, doubtless the same species

[28] *Amer. Nat.* (1885), 19, 349. This bone has also been discovered to exist in *Hyrax*, the duckbill, certain Rodentia, and in some of the Edentates.

as the Bohol specimen, and I will forward the entire head and neck of this in hope that you may be able to dig out the hyoid from it. It has been long in formalin so that the bones may have softened a bit or perhaps hopelessly so, at any rate I think it worth while to forward in case it will complete your description.

If you have already mailed your manuscript you can write out the hyoid matter and send to me with indication where to insert, etc., and I will see that it is properly placed in your manuscript.

Toward the latter part of April, 1909, I received by mail the above mentioned head and found it to be a specimen of the kind described by Mr. McGregor and in a very satisfactory condition for dissection. I have carefully dissected the hyoidean apparatus, the larynx, and about an inch of the trachea (all that came with it) of this specimen.

I have compared all the parts with the corresponding ones of a domestic cat as figured by Mivart, and with several other species of the Carnivora, bats, etc. Upon the whole it agrees pretty well with the first-named animal, except in the matter of the tympanohyal, and it was Flower [29] who said:

The hyoid [in the Insectivora] is formed generally like that of the Carnivora, with three complete extracranial ossifications in the anterior arch, a tranversely extended basihyal, and tolerably long, stout, flattened thyrohyals, sometimes ankylosed with the basihyal.

The tympanohyal in *Cynocephalus,* if it exists at all, is very small and coössifies with certain bones at the base of the skull between the periotic and tympanic elements in the neighborhood of the stylomastoid foramen.

Neither Dobson nor Flower, I believe, ever described the hyoid or the ossifications of *Cynocephalus,* and in fact up to the present time I have not met with any observations of any kind upon this part of the skeleton of the flying lemur.

The specimen at hand is from a fully adult animal and probably ossification in the parts has gone as far as it ever goes in this species, though in individuals attaining an unusual age it may be carried somewhat further.

The anterior cornu has a length of 1.5 centimeters, and the posterior cornu has a length of 6 millimeters, while the average height of the laryngeal box is 7 millimeters, and its width about the same, the former including the crinoid cartilage.

So much of the windpipe as remained with this specimen is composed of vertically narrow, closely adjusted rings. These rings are not large; they are transversely elliptical, performed in elementary bone, and while thinner posteriorly they appear to unite in bone in the medio-vertical line; the first few superior rings certainly do. All the parts usually found in the larynx among the higher vertebrates are present, but it is only in the case of the anterior thyroid alæ that firm ossification is

[29] Osteology of the Mammalia, 176.

observed; all the other elements remain in cartilage and these, apart from the cricoid, fuse more or less together.

The hyoidean apparatus rests directly upon the top of the larynx and it is only the limbs of the anterior cornua, including the epihyals and stylohyals, that stand out independently; these project posteriorly. Each thyrohyal is broadly paddle-shaped, the blade being in front and directly articulating on either side with basihyal. They only connect with the superior cornu of the thyroid by means of cartilaginous extensions. Parallelogramic in outline, the basihyal is nearly flat, being but very slightly concave from side to side posteriorly, and correspondingly convex in the same direction in front. The stylohyals are entirely in cartilage and rudimentary, while both the epihyals and ceratohyals are in bone, each being represented by extremely delicate little rods, making feeble articulations with each other upon either side, and with the basihyal anteriorly.

It will be of interest to mention, incidently, that *Cynocephalus* has a very large thick tongue, finely serrated on the thin edge of its semicircular, anterior margin. The roof of the mouth is peculiarly corrugated in curious, transverse, zigzag lines, and these being raised leave strong similar impressions on the superior surface of the tongue. This last may be of a post-mortem nature and may not exist during life.

## NOTES ON THE OSTEOLOGICAL MATERIAL REPRESENTING THE GALEOPTERIDÆ IN THE COLLECTIONS OF THE UNITED STATES NATIONAL MUSEUM.

After the typewritten copy of this memoir had been forwarded to me by Mr. McGregor for revision and had received my careful reading, it occurred to me that the value of the memoir would be greatly enhanced if certain parts of it were read by such an eminent writer on mammalogy as Mr. Gerrit S. Miller, jr., curator of the division of mammals in the United States National Museum. Mr. Miller at the time was in Europe, and did not return to Washington until the early part of September, 1910. On the first of the following month I took the material I had described, together with the typewritten manuscript to Mr. Miller at the Museum, and after taking up some of the points in the latter, he advised me to make a thorough comparison of the skeletons and skulls of my own collection with those of the far more extensive collection of the Galeopteridæ belonging to the United States National Museum, together with a series of skulls of flying lemurs loaned him by the Bureau of Science. Mr. Miller informed me that all the species of these animals belonging to the Malayan fauna were now contained in the genus *Galeopterus*, and that the Philippine species *volans* was of the genus *Cynocephalus*.

There are a number of Malayan species and perhaps subspecies, but

the skins and osteological material of the Philippine forms were as yet not sufficiently extensive in the National Museum collections to differentiate them. In addition to the above-mentioned material, Mr. Miller placed at my disposal a particularly fine and perfect mounted skeleton of an unidentified Malayan form of flying lemur belonging to the National Museum. This specimen was photographed for me by Professor T. W. Smillie, chief of the photographic division of the National Museum, and the reproduction of this photograph illustrates the present memoir as a frontispiece. It is particularly valuable as showing the skeleton in one of these animals with all the bones, even including the hyoid and trachea, normally articulated. There is listed in the following tables all of the osteological material (October 1, 1910) representing the flying lemurs in the collection of the United States National Museum, which I have compared and studied. The scientific name given is the name on the label attached to the specimen. Such information likewise applies to the locality, sex, and name of collector given. In some instances the condition of the specimen is added.

*Skulls of Cynocephalus from the Philippine Islands, United States National Museum collection.*

| U. S. Nat. Mus. number. | Original number. | Name. | Locality. | Sex, age, etc. | Collector. |
|---|---|---|---|---|---|
| 144663 | 6145 | *Cyanocephalus volans.* | Catagun, Mindanao. | Adult ♂; broken, incomplete. | E. A. Mearns. |
| 144662 | 6046 | do | Basilan Island Isabela. | Adult ♂ | Do. |
| 144660 | 6036 | do | do | do | Do. |
| 144659 | 6034 | do | do | do | Do. |
| 123422 | | Colugo. | Pantar, Mindanao | Not given; adult, perfect. | Not given. |
| 144655 | 6027 | *Cyanocephalus volans.* | Basilan Island, Isabela. | Adult ♀ | E. A. Mearns. |
| 144657 | 6030 | do | do | Broken up; adult ♂ | E. A. Mearns, 1906. |
| 144656 | 6028 | do | do | Adult ♀; perfect | E. A. Mearns. |
| 144658 | 6033 | do | do | Adult ♀ | Do. |
| 144661 | 6038 | do | do | Juvenile ♀ | Do. |

*Skulls of Cynocephalus from the Philippine Islands, Bureau of Science collection.*

| Original number. | Name. | Locality. | Sex, age, etc. | Collector. |
|---|---|---|---|---|
| 105 | Not given | P. B. S. | Adult ♂ | R. C. McGregor. |
| 111 | do | Bohol | Not given | Do. |
| 108 | do | do | Adult ♀ | Do. |
| 104 | do | do | Adult ♂ | Do. |
| 106 | do | do | do | Do. |

*Two skeletons of Malayan species. United States National Museum.*

| U. S. Nat. Mus. number. | Name. | Locality. | Sex, etc. | Collector.* |
|---|---|---|---|---|
| 49640 | *Galeopterus sp.?* | Pulo Bintang | Adult ♀ | (?) |
| 154600 | do | Mount Salak, Tandak | Juvenile, complete | O. Bryant, 1909, Java Expn. |

*Skulls of Malayan species, United States National Museum.*

| U. S. Nat. Mus. number. | Original number. | Name. | Locality. | Sex, age, etc. | Collector. |
|---|---|---|---|---|---|
| 122841 | 2454 | *Galeopithecus* | Malacca Strait, G. Karimon Island. | ♀ adult | W. L. Abbott. |
| 144373 | 5089 | do | Rhio Arch., Pulo Jombol. | do | Do. |
| 144372 | 5088 | do | do | ♂ adult; full of shot holes. | Do. |
| 144377 | 5095 | do | do | ♀ adult | Do. |
| 123035 | 2616 | *Galeopithecus sp.?* | E. Sumatra, Pulo Bakong. | ♂ subadult | Do. |
| 123086 | 2700 | do | E. Sumatra, Pulo Penuba. | ♀ adult; broken | W. L. Abbott, 1903. |
| 123088 | 2717 | do | do | do | Do. |
| 123087 | 2701 | do | do | ♀ adult; perfect | Do. |
| 123069 | 2676 | do | E. Sumatra, Pulo Sebang. | ♂ adult | Do. |
| 112427 | 1000 | *Galeopithecus aoris* | S. China Sea, Pulo Aor. | do | W. L. Abbott, 1901. |
| 104600 | 463 | *G. gracilis* | Natuna Islands, Sirhassen. | do | Do. |
| 104447 | 154 | *G. pumilus* | Butang Islands, Pulo Adang. | ♂ juvenile; perfect | W. L. Abbott, 1899. |
| 121748 | 2235 | *G. saturatus* | Batu Islands, Tana Bala. | ♂ adult; perfect | W. L. Abbott, 1903. |
| 121749 | 2277 | do | do | ♂ adult; badly shot up. | Do. |
| 121747 | 2216 | do | do | ♂ adult; perfect | Do. |
| 115605 | 1884 | *G. volans* | Rhio Arch., Pulo Bintang. | ♀ adult; perfect | W. L. Abbott, 1902. |
| 143327 | 4704 | *Cyanocephalus sp.?* (*Galeopterus*). | E. Sumatra, Pulo Rupat. | (?) | W. L. Abbott, 1906. |
| 143325 | 4696 | *Galeopterus sp.?* (*Cyanocephalus.*) | do | ♀ adult; good | Do. |
| 114376 | 1460 | *Galeopithecus tuancus.* | Banjak Islands, Pulo Tuangu. | ♂ adult | W. L. Abbott, 1902. |
| 121853 | 2353 | *Galeopithecus saturatus* (*Galeopterus*). | Batu Islands, Pulo Pince. | do | W. L. Abbott, 1903. |
| 121854 | 2364 | do | do | do | Do. |
| 3780, 3940 | | *Galeopithecus volans.* | Singapore, Malay Peninsula. | Not given | Explor. Exped. |

*Skulls of Malayan species, United States National Museum*—Continued.

| U. S. Nat. Mus. number. | Original number. | Name. | Locality. | Sex, age, etc. | Collector. |
|---|---|---|---|---|---|
| 3785<br>3946 | | *Galeopithecus volans.* | Singapore, Malay Peninsula. | Not given | Explor. Exped. |
| 3784<br>3945 | | do | do | do | Do. |
| 122766 | | *Galeopithecus sp.?* | Malay Peninsula, Pinic. | do | W. L. Abbott. Parietals dented, killed with blow. |
| 115493 | 1838 | *G. volans* | Rumpin R., Pahang. | ♂ adult | W. L. Abbott, July, 1902. |
| 122888 | 2521 | *Galeopithecus* | E. Sumatra, Pulo Kundur. | ♀ adult; mandible broken. | W. L. Abbott, July, 1903. |
| 49693 | | *G. volans* | E. Sumatra, Pulo Kundur. | ♀ adult; perfect | W. L. Abbott, 1903. |
| 86786 | | do | Trong, Lower Siam. | do | W. L. Abbott, 1899. |
| 84420 | | do | do | do | W. L. Abbott, Mar. 5, 1897. |
| 84421 | | do | do | ♀ young; somewhat broken. | W. L. Abbott, Mar. 4, 1897. |
| 86787 | | do | do | Sex not given; young. | W. L. Abbott, Mar. 4, 1899. |
| 83276 | | do | do | ♂ subadult | W. L. Abbott, Mar. 1, 1896. |
| 151887 | 5701 | *Galeopithecus sp.?* | Pulo Sebuku | ♂ adult | W. L. Abbott, 1897. |

*Skull.*—Taking the series as a whole (Malayan and Philippines) and viewing the skull from above there are a number of points of difference worthy of notice, and these apart from the matters of sex and age. On this view any Philippine Islands specimen can be distinguished at once from any of the Malayan forms by the character of the naso-maxillary arch, taken transversely from alveolar process of one side to the one on the opposite side and including all the region anterior to the orbits. In the Philippine forms this is very broad and rounded; the nasals more or less lying in the same surface; while on transverse section here the line of the curve is circular. In the Malayan forms this region is narrower; as a rule, more acute, and the nasals more in evidence, and raised above the general surface for their entire lengths. In old individuals these bones in all forms (Malayan and Philippines) fuse completely with the bones they articulate with in the face.

In the Malayan forms the superior produced arches of the orbital peripheries are more elevated and, as a rule, much broader than they are in any of the Philippine forms. In all species, the orbital cavity is strikingly circular in outline, with the plane of its margin looking forward, outward, and slightly upward; its cavity, everything else being equal, being markedly greater in the Malayan species than it is in any

of the specimens from the Philippine Islands, at least one-third larger on comparing skulls of equal size. (As 144655 ♀ Basilan Island and 84420 ♀ Trong, Lower Siam.) This character is constant and eminently distinguishing.

One of the most interesting characters on this superior view of the skull is the variation in the extent of the area of the temporal fossæ, and the fact as to whether or not they meet in the median line posteriorly, and to what extent, if they do meet. This character I have carefully examined in the 52 skulls at hand belonging to the National Museum and the Bureau of Science, and in the few skulls of my own collection. On any specimen the surface of one of the temporal fossæ, selecting either side, may be more or less rough. In all forms these areas are very distinctly defined, with the limiting boundary line more or less raised. Now in no Malayan form of flying lemur do the temporal fossæ at all approach each other posteriorly: the interval often being nearly one centimeter in adult skulls of either sex. This appears to be the case with the young of *Cynocephalus* (number 144661 ♀) and still more marked in the young of *Galeopterus*.

Among the Philippine forms this character varies, though in none of them do the temporal fossæ ever approach each other anywhere as closely as in any of the Malayan forms.

Referring to the numbers in the above tables for the specimens and their localities the following are found to be the intervals between these fossæ. In number 144663 it could not be determined as the skull is too much broken up. Of all the skulls from the Philippines the contact is most extensive in number 144655 where the internal margins of the fossæ come in contact for one centimeter, their common borders forming a distinct crest, which extends posteriorly to the occipital crest. In numbers 123422 and 144656, where it is about equal, it is less extensive, the medium crest is less pronounced and does not extend to the occipital crest. The contact is slightly less in number 144658. In numbers 144657 and 144659 there is an interval of one millimeter, and in number 144660 about two millimeters. The greatest interval is seen in skull number 106 where it is equal to the interval in the Steere specimen in my own collection, that is five millimeters; it is slightly less in number 108, and still less in 105 and 111, the interval still being from one to two millimeters. As a rule, then, the approach of the temporal fossæ, posteriorly, is likely to be far more extensive in Basilan specimens than in those from Bohol; in the latter they are rarely, if ever, in actual contact.

Turning to the base of the cranium we find the palatal region, or roof of the mouth, comparatively broader and much more in front in the Philippine specimens than in any of the Malayan species; the tympanic bullæ are much better developed and have thinner walls in the latter than

in any of the skulls from the Philippines. Posteriorly, we find that the form of the occipital area varies to some extent, though as a rule it is lower and more rounded superiorly in skulls of *Cynocephalus* than in any of the others. In the Malayan skulls it tends to become more lofty and oblong in outline, its width averaging nearly double its height.

In *Cynocephalus* the mandible is as a rule, in specimens of the same age and sex, a considerably stronger and deeper bone than in any of the Malayan species. (Compare numbers 121749 and 168.)

Mr. Gerrit Miller has pointed out to me the fact that the milk teeth in Philippine forms (*volans*) more or less resemble the permanent teeth in any of the Malayan species. This is well seen in two skulls prepared for the purpose, namely, number 121854 ♂ (Malayan) and number 105 ♂ from Bohol. To compare all the dental characters would require too much space here. They vary in the two genera and in old age wear down considerably.

*Trunk skeleton.*—Passing to the trunk skeleton it is to be noted that apart from the fact that all flying lemurs possess 7 cervical vertebræ, and as a rule 13 dorsals, they may vary very decidedly in the number of the lumbar vertebræ, as the following table tends to show.

*Vertebræ in Galeopteridæ.*

| Specimen. | Number of vertebræ. | | |
|---|---|---|---|
| | Cervical. | Dorsal. | Lumbar. |
| McGregor specimen in personal collection | 7 | 13 | 7 |
| No. 49640, National Museum, ad. ♀ | 7 | [a]13 | 6 |
| No. 154600, National Museum, juv. | 7 | 13 | 5 |

[a] The 13th supports a pair of free ribs.

Moreover, the characters of some of the vertebræ are different, as for instance, in the atlas. In *Galeopterus* (number 49640) this bone is nearly square in outline, and possesses a fairly well developed neural spine, situated anteriorly. There is no evidence whatever of such a spine in the atlas of *Cynocephalus,* in which genus this vertebra is very much wider transversely than it is longitudinally. The transverse processes of the lumber vertebræ in *Galeopterus* (number 49640) are strongly developed, in every case springing from the entire side of the centrum, and are directed outward and forward. They are much smaller in the Steere specimen (*Cynocephalus*), and in the specimens of this genus sent by McGregor from the Philippines they are nearly entirely absent. Some unimportant differences are seen in the sacral and caudal vertebræ of the specimens here under consideration and, everything else being equal, the ilia of the pelvis in *Cynocephalus* are longer than in the Malayan species.

*Limbs.*—The comparison of the bones of the limbs, although made with care, need not be entered upon to any extent in the matter of description. In the main the long bones are very much slenderer in *Galeopterus* (number 49640) than they are in the specimen of *Cynocephalus* collected by Steere, while they vary very little in their lengths. This is especially well seen in the humeri and in the femora.

In the forearm of *Galeopterus* the radius and ulna still remain distinct in the adult, though the ligamentous union is very close, and in very old animals it is just possible that coössification may take place distally between these two bones. It is fair to presume that for this character Owen, Huxley, and Flower examined old adult specimens of some Malayan flying lemur in the collection of the British Museum or at the Royal College of Surgeons and that without forcing maceration far enough to separate the bones, they came to the conclusion that osseous union had taken place between the radius and ulna distally. Mr. Gerrit Miller was kind enough to examine this character with me, and even went so far as to macerate for several days the forearms of the old *Galeopterus* and the young one in the National Museum collection, and became convinced of the above facts as here set forth.

The scapulæ and clavicles of these two genera are quite similar, and in animals of the same age the differences are scarcely noticeable.

## ILLUSTRATIONS.

(From photographs by the author.)

PLATE III.

FIG. 8. Left lateral view of the pelvis of *Cynocephalus*, natural size, and from the same adult specimen which supplied the bones shown in figures 3 to 7. The leading vertebra shown in this figure is the last or eighth lumbar vertebra.

9. Antero-external aspect of the left radius and ulna of *Cynocephalus;* slightly enlarged and from the same specimen as before, figures 3 to 8. This figure shows the ligamentous attachment of the ulna to the radius. The bones are somewhat pulled apart at their proximal extremities.

10. Ventral view of the first cervical (atlas) vertebra of *Cynocephalus*, adult, natural size and from the same specimen, figures 3 to 9. This is a direct view and the extremity of the bone that articulates with the skull is faced toward the top of the plate.

11. Direct left lateral aspect of the second cervical (axis) vertebra of *Cynocephalus*. From the same specimen from which the other bones were obtained, figures 3 to 10.

12. Direct ventral view of the five caudal vertebræ of *Cynocephalus* (being the fourth to the eighth inclusive), natural size and from the same specimen, figures 3 to 11. When articulated in the skeleton the first three of these vertebræ are between the pelvic bones, the distal extremity of the third being exactly opposite the posterior ischio-iliac border.

PLATE IV.

FIG. 13. Lumbar vertebræ of *Cynocephalus*, being the third to the seventh inclusive and seen upon direct dorsal view. Slightly reduced and the same bones as those shown in figure 7 of Plate II. The seventh lumbar is toward the top of the plate.

14. Direct ventral view of the pelvis of *Cynocephalus;* slightly reduced and the same bone as shown in figure 8 of Plate III. The vertebra in front of the sacrum is the eighth lumbar.

15. Outer aspect of the left humerus of *Cynocephalus*, very slightly enlarged. At the distal end the supracondyloid foramen is partly in view. From same specimen as before, figures 3 to 14.

16. Right humerus of *Cynocephalus;* direct view of posterior surface, and the bone very slightly enlarged. From the same skeleton from which the the one in figure 15 was taken.

PLATE V.

FIG. 17. Right lateral view of the trunk skeleton of *Cynocephalus*, reduced about one-third. Skull removed. This is from one of the skeletons sent from the Bureau of Science. Some of the dried ligaments have not been removed, especially in the cervical region. Spinal column complete. The skull of this specimen is shown in figure 2 of Plate I.

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# ON THE HABITS OF THALASSINA ANOMALA (HERBST).

By A. S. Pearse.[1]

(*From the Zoölogical Laboratory, University of the Philippines.*)

Although *Thalassina anomala,* as Bate[2] (p. 27) says, is of particular interest because it "supplies a link connecting the macrurous with the anomurous Crustacea," but little has been learned concerning its habits. Again quoting from Bate:

"We do not know much of the habits of this animal, but many of the group are burrowers in the deposits beneath the seas in which they live, hence it is more than probable, from the matted condition in which I found the fur that covers many parts of the animal, that it inhabits hollow passages in the mud, and that the circulation of the water through the branchial chamber can not be very vigurous * * *." He believed that the structure of the branchiæ showed that they were capable "of extracting oxygen from water that had been stored for a long period where it has not been affected by the atmosphere."

This peculiar crustacean probably occurs throughout the Philippine Islands. Dr. L. E. Griffin informs the writer that it is common in Oriental Negros, and it is abundant along the estuaries of Manila Bay. In the latter locality it is called *palatak* by the Tagalogs. During the months of May, June, and July, 1911, the writer made many observations on its habits and ascertained that, though Bate's[2] plates of this animal were very inaccurate, his conjectures concerning its habits were in general correct. Though it may burrow "in the deposits beneath the seas," along Manila Bay the mounds of earth (fig. 1) brought out at the opening of its burrows are found at the edges of estuaries near or above the usual high tide mark.

*Thalassina* burrows with the first legs, the dactyls of these appendages being used somewhat like trowels to pull the dirt loose. The animal works a load free and then carries the mass before it to the mouth of the burrow. The load is carried in the first legs between the dactyl and the propodus, and it may also be supported below to some extent by the second legs which are held in a horizontal position. The first two pairs of legs form a sort of a basket which is an admirable instrument for sweeping all loose mud before the animal as it moves through its

[1] Assistant Professor of Zoölogy, University of the Philippines.

[2] Bate, C. S. 1888. Report on the Crustacea Macrura dredged by H. M. S. Challenger during the years 1873–1876. Challenger (1888), **24**, 27.

burrow. The loads of mud are dumped at the mouth of the hole, the first legs being stretched forward while the sticky mass is pushed from them with the second legs. Where the burrow opens above high tide mark the dirt often accumulates and forms a tower, like that shown in Plate I, which may sometimes be nearly one meter in height.

The opening of a burrow is usually closed when it is not being used. On July 4, the writer while sitting within two feet of the *Thalassina* tower shown in Plate I saw its owner "close up" for the day. This individual had apparently been digging actively during the night, for a lot of fresh mud had been thrown over the side of the mound. Soon after 10.00 o'clock in the morning he pushed a mass of mud out to within about 12 millimeters of the open mouth; before 10.42 he had brought two similar loads, the first of which was deposited beside the earlier one. As he carried up the last load the whole mass of fresh mud was pushed up from below so that the top of the tower assumed a more or less rounded contour. When a *Thalassina* opens a burrow that has been plugged he does not always choose the same place and may leave the old exit as a blind passage; this is particularly true of burrows in the softer grounds that are covered by the tide (text fig. 2). On the other hand, holes dug in the hard clay of grassy meadows (text fig. 1) often go nearly straight down until they are below water level. Every burrow explored by the writer was of sufficient depth to have standing water in its deeper portions so that it was impossible to follow it on account of the rapidity with which water seeped in.

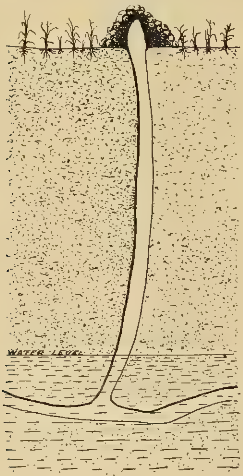


Fig. 1.

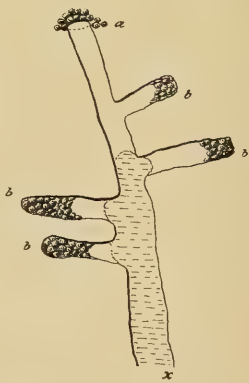


Fig. 2.

Through the study of the structure of preserved specimens, Bate surmised that *Thalassina* was able to live in poorly aerated water, and its habits are such that this ability would often be of advantage. It possesses an adaptation that is probably for this purpose, that is, the branchiostegites are movable on the dorsal portion of the carapace by a sort of flexible hinge-joint. An individual placed in a dish will often move the sides of the carapace in such a manner that it resembles a vertebrate gasping for breath. Such movements would serve to clear the water quickly from the branchial chamber.

Judging by an examination of the stomach contents of a medium sized female captured at 11.00 in the morning of July 20 and examined about two hours later, *Thalassina* is a vegetarian. This stomach contained a little fine silt, many bits of vegetable tissue (apparently largely from the stems of vascular plants), a root tip, and a small grass plant bearing several leaves and roots. These things indicate that the food came largely from the pasture land at the edge of the estuary, for the most careful examination failed to reveal any algæ. Algæ are always abundant in the stomachs of the fiddler crabs that dig their holes beside those of *Thalassina* and feed over the wet mud-flats during the day.

The *Thalassina* is extremely shy. Most of its burrows are closed during the day, but more of them are open on rainy or cloudy days than when the weather is clear. When handled or placed on the ground this crustacean is slow moving and cautious rather than pugnaceous, attempting to hide or to creep away. It is apparently nocturnal or becomes active in the twilight, for fresh mud is usually seen at the mouth of burrows in the morning, rarely in the afternoon. Though *Thalassina* depends largely on its secretive habits to protect it from its foes, once it is in the hand of its enemy the many spines on the surface of the body and legs form an admirable adaptation for escape. Those on the body all point toward the anterior end and when in the grasp of an enemy serve to prevent the body from slipping forward but facilitate movement in the opposite direction. It is surprising how hard it is to hold an animal that pushes your hand forward frantically with its legs; the spines do not allow the fingers to regain their hold easily. Hence *Thalassina* often slips to the ground and backs into the nearest burrow.

The Filipinos assert that the *palatak* makes sounds, and they attempt to imitate them by making a popping noise with the tongue, similar to that made by the cork of a beer bottle as it is withdrawn. The writer has often heard such sounds when among the *Thalassina* burrows, and has produced a similar sound by rubbing that animal's first leg along the curved row of spines on each side of carapace, but has never seen this species stridulate.

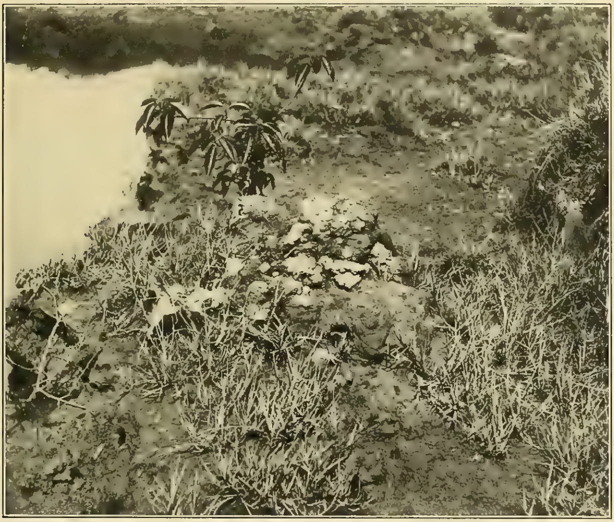

PLATE I.

The Philippine Journal of Science,
D. General Biology, Ethnology and Anthropology.
Vol. VI, No. 4, August, 1911.

# CONCERNING THE DEVELOPMENT OF FROG TADPOLES IN SEA WATER.

By A. S. Pearse.[1]

*(From the Zoölogical Laboratory, University of the Philippines.)*

It has long been believed that amphibians are unable to withstand salty water. Gadow[2] says:

> Common salt is poison to the Amphibia; even a solution of 1 per cent prevents the development of their larvae. Consequently seas, salt lakes, and plains encrusted with saline deposits act as most efficient boundaries to normal "spreading."

Some observations at Manila during the summer of 1911, which show that certain frogs live and breed along the swampy edges of estuaries where the water is almost as saline as that of the ocean itself, are of interest in this connection.

During the month of May, the writer had occasion to spend many quiet hours along the edge of an *estero*[3] not far from its opening into Manila Bay. He was struck by the fact that frogs were often seen to hop about on the flats at low tide and to dodge into the crab[4] holes filled with salty water. Four of these frogs captured on July 13 were all referable to the genus *Rana* and, though they apparently belonged to a single species, it could not be determined with the literature at hand. They were all small, measuring respectively 35, 34, 32, and 18 millimeters in length.

On June 17, at 8.20 in the morning the writer observed that two crab holes at the edge of the *estero* were filled with a wriggling mass of newly hatched frog tadpoles. These holes had been seen to be left above low-tide mark with water standing in them and to be covered by water at high tide on each of the three days previous. On the date mentioned, they were submerged by the advancing tide at 8.30 in the

[1] Assistant Professor of Zoölogy, University of the Philippines.

[2] Gadow, H. Cambr. Nat. Hist., London (1901) **8**, 72.

[3] An *estero* is a small creek into which the tide flows.

[4] *Sesarma bidens* (de Haan).

morning and the tadpoles streamed from them into the salty water; at 9 o'clock a tadpole was seen swimming 6 meters from the hole where it hatched. At 2 o'clock in the afternoon, after the tide had begun to ebb, a sample of water was taken directly over the holes where the tadpoles had been observed in the morning. This was analyzed by Mr. V. Q. Gana of the Bureau of Science and found to contain 18.7 parts of chlorine per 1000, the equivalent of 26.44 grams of sodium chloride per liter, or a 2.64 per cent solution. These frog tadpoles, then, apparently developed in crab holes that were left exposed at every low tide and covered by 30 and 60 centimeters of water respectively at high tide.

On July 6 samples of water were collected from two pools, on the edge of the *estero,* both of which contained tadpoles. The dimensions of the first pool were about 2.5 by 2 meters. This pool was connected with the main *estero* by a narrow ditch, so that the two communicated at high tide. The second pool was larger, being about 10 meters square and though it was connected with the *estero* by a ditch, was not flooded with salt water so often because it was on a higher level. The tadpoles taken from the first pool were nearly ready to metamorphose into frogs and had well-developed legs; those from the second pool had been hatched only two or three days. Mr. Gana's report on the amount of chlorine per liter was as follows:

| | Grams. |
|---|---|
| Sample from first pool | 14.851 |
| Sample from second pool | 7.920 |

The tadpoles in the former, therefore, were living in a 2.096 per cent solution of sodium chloride; those in the second pool in a 1.124 per cent solution of the same salt.

The observations described show that amphibian tadpoles developed in slightly diluted sea water, containing as high as 2.096 per cent of sodium chloride and make it seem probable that the same thing occurred in a 2.644 per cent solution.

# REVIEWS.

**The Biological Stations of Europe.** By Charles Atwood Kofoid. United States Bureau of Education Bulletin No. 4, 1910. Illustrated. Pp. xiv–360.

This bulletin of the United States Bureau of Education is a most welcome and opportune volume. It forms a splendidly illustrated book of 360 pages, conveniently arranged and indexed. Doctor Kofoid has based his report largely upon a personal visitation and investigation of the fresh water and marine biological stations of Europe and the results of personal knowledge are plain throughout the work. Every American biologist should possess and make a careful study of this book, not only because of the descriptions and photographs of the stations, with detailed plans of buildings, aquaria, and fixtures which are presented, but also because the practical objects to be attained through biological stations are clearly stated. In the mind of the American public and, it is to be feared, in the minds of most biologists also, biological stations are considered as educational luxuries, not as economic and scientific interests of the nation. If he does not look upon them as pleasant summer resorts for teachers and students, the biologist is still quite apt to consider that they should be laboratories for research in pure science. One does not need to be a prejudiced admirer of all things German in order to recognize the value of the different attitude of the middle European countries toward the function of biological stations; it is in Germany and Austria-Hungary that they are performing their most noteworthy economic work. Stations for the investigation of pond culture of fishes and crayfish; of river and lake life; of the control and biological utilization of sewage; of the effect of sewage and chemical by-products upon the animals inhabiting rivers and for the active control of evils arising from these causes, do not lessen the scientific activities of their workers but rather increase them, by giving definite aims and purposes to the researches.

According to Doctor Kofoid's report, there exist in Europe 85 biological stations, of which 27 are located on fresh-water. The distribution is worth noting. Italy has 4, France and Monaco 20, Great Britain and Scandinavia 12 each, Germany and Austria-Hungary 10 each, Holland and Finland 3 each, Russia 7, Spain 2, Belgium and Bulgaria 1 each. The disparity between the number of biological stations in Germany and France is superficial, for it must be remembered that Germany is largely

the supporter and founder of that at Naples, while one of the best of the French stations, Villefranche, is related to, although not under, the administrative control of the University of Kief of Russia. The geographical location of the seashore of Germany has turned a very considerable number of the biological students of Germany to the Naples station, while the French students have been able to seek work on their own more favored coast. This is indicated by the list of the attendance at Naples, which Dr. Kofoid gives by countries during the years of 1873 to 1909. Out of 1,934 occupants of research tables, Germany furnishes the largest number, namely, 630, while France furnishes but 4. The United States is sixth in this list of countries.

The report deals very clearly with the economic or applied scientific activities of the biological stations. One particularly valuable feature lies in the statements made of the objects which certain stations are attempting to accomplish, and the lines of investigaion which are being followed.

The distribution of the fresh water stations, and their numbers in the various countries as compared with the marine stations, is significant both of the geographical location and of the economic interests of these countries. In France four out of 20 stations are fresh-water. In Great Britain but one out of 12, in Germany and Austria-Hungary, each, six out of 10, in Scandinavia four out of 13, in Finland two out of 3, and in Russia three out of 7.

Thirty-nine of the 85 stations, may be termed independent; that is, they are supported either by private individuals or by societies, or by local societies in conjunction with private persons and are not controlled by the government or by a university. Nearly all of these independent stations receive grants of money from their respective governments but without being brought thereby under governmental control. It is significant that these independent stations on the whole, include, the finest of all, such as that at Naples, the Institute of Oceanography at Monaco, the Plymouth Marine Biological Stations, and stations of the Liverpool Marine Biological Committee.

Twenty are supported by universities, generally as coördinate divisions of the Zoölogical departments. The development of the university biological stations in France is noteworthy in contrast with other European countries, for 13 are related to French universities while a fourteenth, that at Villefranche, is related to the Russian University of Kief. In Germany and Austria-Hungary but a single university possesses its own zoölogical station. This is no doubt to be explained by the fact that the governmental department of public instruction to a large extent controls and supports all of the stations of these countries.

There are thus remaining 32 stations in Europe which are directly supported by governmental agencies. All of these and about half of the

first group are primarily engaged in economic biology. The short histories of the development of each of the more important stations form a particularly interesting feature of Doctor Kofoid's book, and one which will be greatly appreciated by his readers.

LAWRENCE E. GRIFFIN.

---

**The Racial Anatomy of the Philippine Islanders.** Introducing new methods of anthropology and showing their application to the Filipinos, with a classification of human ears, and a scheme for the heredity of anatomical characters in man. By Robert Bennett Bean, B. S., M. D. Cloth. Illustrated. Pp. 236. Price $2, net. Philadelphia & London: J. B. Lippincott Company, 1910.

The author's thesis is admirably set forth in the preface as follows:

"This book represents studies of the human form rather than the skeleton, and embodies the results of three years' investigation of the Filipinos. A method of segregating types is introduced and affords a ready means of comparing different groups of men. The omphalic index is established as a differential factor in racial anatomy, the ear form becomes an index of type, and other means of analyzing random samples of mankind are presented for the first time. The book, therefore, represents a new departure in anthropology, and the term racial anatomy of the living is not inappropriate as a title. Approved methods of the Old World have been utilized, and it is to be hoped that this contribution from the New World will be received with due consideration as a striving after truth. * * * The object of this book is to establish definite types of man that may be recognized by ear form, cephalic index, nasal index, and other factors, that such types may be studied in families through several generations to establish their hereditary characteristics, and this is the author's reason for the present publication."

The conclusions arrived at may be divided into three very distinct classes: I. Those relating to *methods* of physical anthropology; [1] II. A new classification of the whole human race, based upon the results of the new methods employed; and, III. The classification and corelation of the people of the Philippine Islands.

CLASS I. *Old methods of somatology:* The cephalic index has long been held to be the most permanent physical characteristic of man. Doctor Bean throws grave doubt on this assumption, affirming that the manner of sleeping seriously affects the shape of the head. This is particularly true in the Orient where the Chinese sleep on porcelain beds, the lowland Malays on mats laid upon the floors, and the mountain peoples on sleeping-boards of hard wood. However, Doctor Bean uses the cephalic index in his work, as well as the nasal index, facial index, height, reach, and other anthropometric measurements in common use by somatologists. 2. *New methods of somatology:* Two entirely new factors in the deter-

[1] It is to be regretted that the author does not use the more precise term "somatology," now in general use by leading anthropologists.

mination of physical type are introduced by Doctor Bean, namely, Ear Type and The Omphalic Index.

"Types of human ears are established for the first time, and each ear type is associated with a physical type of man. * * * The types of ears not of European origin are morphologically older than the European ears. The Spanish population of Manila has ear types which are closely simulated by the European types among the Filipinos. * * * Ear type seems to be independent of pigmentation to some extent, because the same type of ear is found on blond and brunette Europeans, on dark-skinned and light-skinned Filipinos, and on dark-skinned Indians and light-skinned Chinese."

One of the most important factors in favor of ear type as a means of somatological classification is that it is so little modified by natural selection. The Omphalic Index is described by the author as follows:

"The position of the umbilicus in relation to the pubis and the suprasternal notch, although it is more variable than the two points last mentioned, is of importance in the differentiation of the species of men. * * * The index is found by dividing the distance of the umbilicus from the pubic spine by its distance from the suprasternal notch. This indicates its relative position on the body. If the index is high, the umbilicus is relatively near the suprasternal notch, but if low, it is relatively near the pubic spine. I propose the name of Omphalic Index for the index of the umbilicus."

Class II. From a study of the measurements of 2,500 white Americans, 100 American negroes, 1,500 lowland Filipinos (chiefly Tagalog), and 104 Igorots of Benguet and Bontoc, together with various smaller numbers of published measurements of Russians, Siberians, Chinese, Japanese, etc., the author finds but three systematic species of the genus *Homo*. These he names Iberian, Australoid, and Primitive. The Iberian is the fundamental European type, the Australoid the fundamental negroid type, and the Primitive the fundamental type of the Orient and of the Pacific peoples. But among all races, and in all countries of the world thus far examined, all three types are to be found in varying proportions.

"Among Europeans the other types resemble the Iberian; among negroes the other types resemble the Australoid; and among Orientals the other types resemble the Primitive. The composition of any group of people, large or small, depends on the relative proportions of each type that entered into the composition of the group, the time during which the types have been in contact, the conditions of food, water, air, habits, etc., and other factors. There is no evidence that any type of man that ever existed has disappeared entirely,[2] although there is evidence that the types have become somewhat modified in different parts of the world."

Class III. In his study of the people of the Philippines Doctor Bean finds the three systematic species already mentioned, and these he further divides into twelve varieties, viz., Iberian A, B, C, D, Primary and

[2] In connection with this statement attention might be called to the Tasmanians, as a possible exception.

Secondary Australoid, Primitive, Modified Primitive, Blend (?), and Adriatic. In addition to these varieties he finds four further types, the Cro-Magnon (?), B. B. B. (?), Australoid, and Alpine, which he considers are elementary species being at present developed from amalgamation of various combinations of the above varieties.

"The word Malay has been avoided purposely so far because I have been unable to decide to my own satisfaction what is the Malay type, if there is such a type. My opinion is that the Malay is a composite of the Iberian from Europe, the Primitive from Asia, and the Australoid from its primary center, wherever that may have been. * * * If the Australoid and Primitive types represent the original elements of the Filipinos, and the other types represent modifications caused by Europeans and Chinese, recent and remote, then the individuals of the present population are larger than the original in all physical characters. Continued immigration, with consequent interbreeding of Americans and Chinese with the Filipinos, will result in further increase of size. With increase of size go increase in bodily and mental vigor. Advance on the part of the Filipinos will be coincident with and incident to the continuation of the amalgamation of the races, although better nutrition, fewer animal parasites, and improved hygiene may assist in the advance."

An appendix is added to the book giving a detailed description of Doctor Bean's *Homo philippinensis*. Only a single specimen is described, and it would seem that we should await the evidence of further research in the Philippines, and in the East Indies generally, before ascribing much importance to this type.

In Chapter VII, "The Relation of Morphology to Disease," the author attempts to show that tuberculosis in the Philippines is confined almost exclusively to individuals of the Iberian type. He also holds that the Iberian is more susceptible to all diseases than is the Primitive. As all of the persons examined were from Manila, or the immediate vicinity, it would be interesting to have further data on this point gathered from other parts of the Islands.

Though several leading anthropologists have, within recent years, arrived at conclusions similar to those of Doctor Bean with regard to the classification of the human race, and as to the compound nature of the type formerly known as Malay, yet no one, within the knowledge of the reviewer, has set down his conclusions so clearly and definitely as has the author of the book under consideration. It may safely be predicted that the work of Doctor Bean will give a great impetus to further investigation along the lines suggested, and, whether his striking conclusions be justified or not, the result will be a distinct addition to the sum of our knowledge regarding the origin and development of the present existing peoples of the earth. It may well be that it will give us some insight also into what will be the future effect of the general amalgamation of races that is now so universally taking place.

The typography of the book, and the illustrations, mostly from photos by Worcester and Martin, are excellent, although there is certain evidence

of a too hasty reading of the proof. A little care would have eliminated such errors as that on page 144, where Fr. Joaquín Martínez de Zúñiga's "Estadismo de las Islas Filipinas" is cited as "P. Martinez makes the statement in his book 'Estadismus de Filipinas,' etc."

In explanation of the absence of references the author says:

"No attempt has been made to give references to the literature, because references have been given already in the *Philippine Journal of Science*, where the original monographs of the author covering a part of the subject matter of this book have appeared from time to time during the past few years."

In conclusion, attention may be called to two recent papers [3] in which Doctor Bean gives the results of some further investigations, and sums up his conclusions with even greater clarity than in the book itself.

Regardless of the effect of future investigations upon his conclusions, the work of Doctor Bean marks a distinct step in advance in the science of somatology.

H. Otley Beyer.

[3] *Am. Anthrop.* (1910), **12**, 220–236; *Ibid.* (1910), **12**, 377–389.

# ILLUSTRATIONS.

PLATE I.

Shore of an estuary showing a mud tower raised by a *Thalassina* over the mouth of its burrow.

TEXT FIGURES.

FIG. 1. Section to show the plan of a *Thalassina* burrow excavated July 4. Distance from surface of ground to bottom of burrow about 1.2 meters.

2. Diagram showing a plan of the mouth of a *Thalassina* burrow excavated July 2; the distance from *a* to *x* was about 0.75 meter, the depth at the water level, 0.30 meter below the surface of the ground. *a*, open entrance; *b*, closed entrance.

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THE PHILIPPINE
# JOURNAL OF SCIENCE
D. GENERAL BIOLOGY, ETHNOLOGY AND ANTHROPOLOGY

VOL. VI NOVEMBER, 1911 No. 5

# AN IFUGAO BURIAL CEREMONY.

By H. OTLEY BEYER.

(*From the Division of Ethnology, Bureau of Science, Manila, P. I.*)

AND

ROY FRANKLIN BARTON.[1]

(*From the Bureau of Education, Manila, P. I.*)

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[1] Supervising teacher, Kiáñgan, Subprovince of Ifugao.

## PART I. INTRODUCTION.

The religious and public ceremonies of the Ifugaos of northern Luzon are probably as highly developed as any such ceremonies to be found in the whole Malay-Polynesian area, and their religion is so closely interwoven with the daily life of the people that its importance can scarcely be exaggerated. Every event of life is accompanied by its appropriate ceremony, and the greater the event the more elaborate the ceremony.

The purpose of this paper is to describe the ceremonies connected with the burial of beheaded bodies and the bodies of persons killed by hereditary enemies, whether or not their heads be taken. With the passing of the custom of head-hunting, these and all other ceremonies more or less directly connected with that custom will soon fall into disuse or materially change their form. It is desirable that an accurate record of them be made before they become wholly matters of hearsay and valuable details are lost. For this reason the authors offer no apology for here presenting a detailed account of such of these ceremonies as have come under their observation.

To understand the ceremonies clearly, some knowledge of Ifugao general customs is necessary. The most important facts are briefly set forth in the following paragraphs.

### THE IFUGAO CLANS AND THE FORMER PREVALENCE OF HEAD-HUNTING AMONG THEM.

The Ifugao people are divided into a large number of hereditary clans, each of which occupies a definite clan district and has a definite name. They vary in population from a few hundred up to four or five thousand people each, distributed in from ten to a hundred or more villages. In most cases, each clan is cut off from those surrounding it by natural barriers such as rivers, cañons, and mountain ranges. The people invariably call themselves by their clan name, with the prefix *i-* (equivalent to the English preposition "of"). Thus: *I-banauol-kami*, "We are (people) of Banauol clan"; *I-nagakáran-kami*, "We are (people) of Nagakaran clan". These clans were once wholly exogamic, as all members of the clan were believed to be descended from a common ancestral pair. Within recent years the exogamic feature has more or less broken down, and the whole clan organization is in the process of slow disruption.

Among these clans the institution of head-hunting grew up, in ages past. Each formed a little state, politically independent of all the other clans surrounding it, and making war or declaring peace with them, as it chose. In war, the head was regarded as a trophy, as was the scalp among the American Indians. The chief reason for desiring the head was not so much the excitement of the actual fighting to secure it, in which only a very few people took part, as the fact that the possession of a head was necessary before the great head-ceremony (or celebration of victory) could be held. This ceremony, in which all the people of the clan took part, was one of the three greatest given by the Ifugaos. It is not the purpose of this paper to describe it, but rather the exactly opposite one given by the clan of the beheaded man at his burial, the *munhímûn̄g*, which is also one of the three greatest Ifugao ceremonies.

### THE SUPPRESSION OF HEAD-HUNTING BY AMERICAN AUTHORITY.

The first task that confronted the American government in the Ifugao country was the unifying of the Ifugao clans, the establishment of peace among them, and the suppression of head-hunting. The rapidity and completeness with which these objects were attained after the organization of the Subprovince of Ifugao in September, 1908, has few parallels. No heads have been taken in Ifugao for more than two years past, nor has there been any fighting among the clans. About 450 kilometers of new roads and trails have been built which greatly facilitate communication between the various clans, and have been one of the chief factors in the development of the era of peaceful intercourse now in progress.

The better features of Ifugao culture will develop rapidly under these conditions, while many of the older customs will become much changed or entirely lost. To preserve the knowledge of them for future generations they must be studied and recorded at once.

### THE MUNHÍMÛÑG BURIAL CEREMONY.

*Sources of information.*—The writers of this paper have each resided for several years among the Ifugao people. The writer of this introduction witnessed, in whole or in part, four *munhímûñg* burials in the Central Ifugao area, and Mr. Barton one in the Kiañgan Ifugao area. Two of these ceremonies will be described very briefly, and two in full detail. The other will be mentioned only.

The sole previously published description of one of these ceremonies is that given by Jenks,[2] who, as a member of the party of Mr. Dean C. Worcester, arrived at Banaue in April, 1903, just in time to witness the burial of a beheaded man, but not the preceding ceremonies. The description is very brief, but the two plates[3] published with it are of interest. These plates are from photographs taken by Mr. Worcester at that time, and show the beheaded body in the procession and at the tomb. The pictures are typical of the ceremonies witnessed by the writer, excepting that usually 4 men in place of 2 carry the body in the burial procession. The statement that only about 20 men accompanied the body to the tomb[4] indicates that the beheaded man was of low rank in the community. The case is very similar to the first *munhímûñg* ceremony that I witnessed; that of Mañgíli of Panañgan who was killed and beheaded in an expedition against Kambulo clan, and was buried by Banauol clan on June 6, 1906. He was a serf of Tagtagon, the head chief of Banauol, who bore the expenses of the ceremony which was not very elaborate and was poorly attended.

### THE DEATH AND BURIAL OF BATTAÑG.

On June 30, 1906, Battañg, an Ifugao chief of great prominence, was killed at his house in the village of Bokos (clan district of Banauol) by an hereditary enemy from the clan district of Kambulo. Conditions were rather unsettled

[2] *Ethnological Survey Publications*, Manila (1905), 1, 182, 183.

[3] *Idem*, Plates CXXXV and CXXXVI.

[4] There is an error in Jenks' statement as to the number of men in this instance. [D. C. W.]

in Ifugao at that time and Battang's death created great excitement among the people. Nearly 5,000 persons from all parts of Central Ifugao and Western Ifugao attended the ceremony, and more than 1,500 men, fully decorated for the occasion, marched in the procession which conveyed the body to the tomb. This was the largest gathering of people for a similar purpose that I have ever witnessed in Ifugao. Through the misfortune of having exposed my last film a few days before the event I was unable to obtain photographs. The procession was very elaborate and required more than an hour to pass a given point. From 200 to 300 men attended the vengeance ceremonies held on the 6 successive mornings following the burial.

### THE DEATH AND BURIAL OF KALATOÑG.

Kalatoñg of Kambulo (Plate I, fig. 1) was a man of very interesting character. He was born in Barlig, in the Subprovince of Bontok, and was of mixed Bontok and Ifugao parentage. He early won fame both as a warrior and as a diplomat, and married the daughter of a wealthy chief of Kambulo. As is common in Ifugao, he took up his residence in his wife's village, and soon attained much prominence in the Kambulo clan. This excited the jealousy of the other chiefs, who began to plot against him. Their plot was successful and late in the year 1905 Kalatoñg was imprisoned in Banaue on a charge later proved to have been false. When Lieutenant Jeff. D. Gallman (now Lieutenant-Governor of Ifugao) took charge at Banaue he carefully investigated Kalatoñg's case and completely exonerated him. During the investigation, at which I was present, Kalatoñg made the most remarkable speech in his own defense that I have ever heard made by any Ifugao. He held even his enemies, who filled the room, spellbound. After Kalatoñg's release he attained to a power which up to that time no other Ifugao chief had ever possessed. He completely dominated the clans of Kambulo, Batâd, Talbok, and Ginihon, containing more than 12,000 people. However, in acquiring this great influence he made many enemies, and some of them very bitter ones. He was a man with a very highly developed sense of justice, and ruled his people with tact, diplomacy, and courage, going alone into the most dangerous places. This eventually brought about his death, for he was so just in his dealings with the people and with Lieutenant Gallman that his enemies decided that the only way they could rid themselves of his rule was by killing him. In January, 1908, three men of Ginihon clan treacherously speared and beheaded Kalatoñg while he was bathing in the Ginihon River. As Ginihon clan had been very inimical to Kambulo before they were conquered by Kalatoñg, they immediately made the latter's death the occasion for a great head ceremony. However, they dared not keep the head, for fear that the combined vengeance of Kambulo and the powerful town of Barlig would wipe them out completely. They opened negotiations at once, and returned the head to Kambulo from whence it was brought to Banaue. The photograph for Plate II, fig. 1 was taken by me at Lieutenant Gallman's house on the day the head was brought in. It was raining heavily and the negative is poor. So far as I know this is the first and only negative of a freshly-taken head ever made in the Mountain Province, and for that reason a print from it is here reproduced. A disabled foot prevented my attending the great ceremonies at the burial of Kalatoñg's body, but they were graphically described to me afterwards by Lieutenant Gallman.

The burial ceremonies on all above occasions were, with the exceptions noted in the text, similar to those given at the *muñhímûñg* of Bahatan, now to be described.

## PART II. THE BURIAL OF BAHATAN.[5]

### THE LIFE AND DEATH OF BAHATAN.

Bahatan of Añgádal was in early life a serf of Tañggána,[6] one of the wealthiest and most popular village chiefs of Banauol clan. When the first Americans came to Banaue, Bahatan found employment with them, and proved exceptionally faithful and intelligent. His employment was remunerative and he was soon able to redeem the mortgaged rice terraces inherited from his father. He then married a well-to-do girl with several fields of her own, and became a substantial middle-class citizen. In 1907 he was enlisted in the special Ifugao police. These Ifugao policemen hold responsible positions, but Bahatan proved fully equal to the work and soon became the most trusted and capable man at the Banaue station.

On March 31, 1908, Bahatan went to a village in Namulditañg district on a matter of business connected with the roadwork then in progress. Having accomplished his errand before noon, he was resting under the house of the village chief when a man of the Liñgai clan came up. Liñgai had not then been brought under governmental control, and was still at war with Banauol. Moreover, the man in question had lost several ancestors and relatives in fights with the Banauol people. He at once determined to kill Bahatan. He approached him with fair words, drawing his blanket closely around his body to conceal his bolo, and offered Bahatan a betel nut which the man from Liñgai intentionally dropped upon the ground. As Bahatan stooped to pick up the nut the man quickly threw off his blanket and with two well-directed blows of his bolo severed Bahatan's head from his body. The man did not stop to take the head. Before the people in the vicinity fully realized what had happened, he had vanished in the *runo*[7] thicket surrounding the village, eventually escaping safely to Liñgai.

### THE BRINGING IN OF THE BODY.

There was great excitement and grief in Banauol when the news reached us. Several hundred armed warriors assembled within a few hours, ready to go after the body and look for a fight on the way. However, Lieutenant Gallman would not let them go, although he had some difficulty in restraining the warriors. Only the wife, mother,

[5] By H. Otley Beyer.

[6] See figure on left, in Plate V.

[7] *Runo*, a species of large grass, common throughout the Philippines. Ifugao name: *biláu*. Scientific name: *Miscanthus sinensis* Andr. (Gramineae). This and following plant identifications were made by Elmer D. Merrill, botanist of the Bureau of Science, from specimens collected by the authors.

and a few near relatives of the dead man were allowed to accompany the detachment which was sent at once to recover the head and body. This object was accomplished without trouble as both had been cared for in the village where the killing had occurred. The party came back too late that night to allow me to take separate photographs of the head and body, or of the returning people. The picture shown in Plate IV, fig. 1, was taken on the following morning, after the head had been replaced upon the body and securely tied to the shield and post against which the body lay. It would have been a serious sacrilege to have asked for its removal then.

During the absence of the expedition, religious ceremonies were performed in every village in Banauol where the requisite priests could be had. The purpose of these ceremonies was to insure success for the expedition, and the classes of beings principally invoked were the *a-ámûd* (ancestral souls) of Banauol clan and the *halupe* (tormentors and go-betweens). Thousands of the ancestral souls were called upon by name in the various villages, particular attention being paid to famous warriors and brave fighters of the past. These were counselled to aid those who had gone out to get the head and body, and to prevent the *a-ámûd* of the Lin̄gai people from injuring them or placing obstacles in their path. The tormentors were urged to torment the Lin̄gai warriors with blindness and dizziness and to fill them with fear, so that they would not attack the rescue party. The only gifts offered the spirits during these ceremonies were small chickens, rice-wine (where it was obtainable on such short notice), betel nuts, and betel leaves. However, great gifts of hogs and other things were promised if the expedition proved successful.

The procedure of the returning party was as follows: The body and head were securely bound on the dead man's shield, which had been taken along for that purpose, and the whole suspended from a long pole borne on the shoulders of four men, two in front and two behind the body. Immediately in front of the pole-bearers walked two men, one of whom beat a sharp tattoo at regular intervals upon his shield with the handle of his spear, while the other played the *ban̄giban̄g*.[8] The relatives of the deceased, except the wife and mother, followed in single file behind the pole-bearers. In former times a long line of warriors would have preceded the party, but in this case that service was performed by the detachment of Ifugao soldiers that accompanied it.

[8] The *ban̄giban̄g* is a musical instrument of very hard and resonant wood which is beaten with a short stick also of hard wood. On a still day the sharp, clicking beat of this instrument can be heard miles away. It is used only in death ceremonies and in the ceremonies for the cure of very serious illness. (See Plate I, fig. 2.)

The wife and mother walked beside the corpse, at times throwing their arms around the bloody body and weeping violently. At other moments they stared into the gruesome features of the head and cried out: "Bahatan! Bahatan! Come back, come thou back!"[9] Occasionally the whole party broke forth in the Central Ifugao death-call: "Oh! Bahatan! Come back, come thou back, for our houses are filled with mourning!"[10] In fact, grief was the keynote of the occasion. Vengeance did not become predominant until the following day.

### THE CEREMONIES AT THE HOUSE.

A group of people of considerable numbers, among whom were several priests and village chiefs, were gathered at Bahatan's house when the party returned. As soon as the cries, which filled the air for fully twenty minutes, had quieted down, two old priests made a short *baki* (religious ceremony) in the house, sacrificing a chicken to the *bagol* (great deities) of the Sky World. Immediately upon completion of this ceremony, the omen being good, the preparation of the body began. Everything was arranged as shown in Plate IV, fig. 1, in which position the body remained until it was removed for burial on the third day. The body faced Liñgai, the murderer's clan district, and rested against the shield on which it was carried in.[11]

During this preparation of the body certain things were also being done by some of the old women to the widow, mother, and brother of the deceased. The clothing and ornaments of the latter were all removed and they were arrayed in old, torn garments made of coarsely-woven bark fiber, such as are worn by the poorest serfs when working in the fields. (See Plate VI, fig. 1.) Rings and bands of woven rattan, called *ñguhu*, were placed upon their arms and the calves of

[9] *"Bahatan! Bahatan! Mabáñga-báñgad-ka!"* The grief of an Ifugao wife or mother over the dead body of her husband or son is something that no one can look upon untouched. I know of no people who exhibit stronger family affection.

[10] *"Bahatan-ah! Mabáñga-báñgad-ka! ta nalagídan di bale-túu!"* This death-cry in Central Ifugao is set up by all the people of the village at the death of any person, and is repeated for from ten to thirty minutes. The name of the dead person is of course changed in each case.

[11] The wooden spear, in the picture, standing beside each of Bahatan's arms, and the little carved wooden ornament suspended from his neck, are of particular interest. The wooden spears, which are really throwing javelins, are called *tukâb* and consist of a pointed bamboo head set in a hard wood shaft. The *tukâb* is undoubtedly the oldest form of Ifugao spear, dating from long before the introduction of metals. It is still largely used in real fighting. The little wooden ornament suspended from Bahatan's neck is called *kiníllo* and indicates that he was *lóhôp*, that is, a brave warrior who has taken heads in his lifetime. At the burial of Mañgîli, mentioned in Part I of this paper, no *kiníllo* was suspended from his neck as he had never taken a head.

their legs. Larger bands of the same sort were also worn by the brother upon the crown of his head and by the women around their necks. Earrings made of small cross-sections of *runo* stalks were placed in their ears, and the widow also wore a necklace made of the same material. The faces, arms, and legs of all three were then rubbed with a mixture of soot and ashes, and in this condition they remained for the next three days. During that time they ate no food and drank very sparingly of water. The widow and mother were prohibited from bathing for a full month after Bahatan's death, and the brother for ten days after the burial. Certain articles of food were also taboo to them during this period. They might not mix much with other people nor go on long journeys from home. Neither were festivities of any sort to be held in the house nor participated in. For her full twenty-eight days of mourning, the widow continued to wear her coarse clothing, and also wrapped around her head (in the manner shown in Plate VI, fig. 3) a striped blanket.[12]

A number of the other relatives and very near friends of Bahatan also removed their ornaments and wore ear-rings or necklaces made of pieces of *runo* stalk. These people also ate little and did not bathe until after the burial. However, in their case it seems to have been purely a voluntary and personal matter. Continence is maintained among young and old throughout the clan district of the beheaded man during the three days between the death and burial, and by some of the nearer relatives during the six succeeding days. This taboo is said to be very rigidly adhered to.

After everything had been prepared, conditions remained practically unchanged during the following two days. Fifteen or twenty men, with their spears and shields always within easy reach, remained under or around the house at all times. They were relieved at frequent intervals, and there was a constant coming and going. Many people came simply to view the body, to get first hand information regarding the fight, and to learn what revenge was planned. The calling on the soul of the dead man never ceased. At intervals of every two or three minutes, both day and night, an old woman approached the body and poking at the severed neck with a slender stick about 80 centimeters long she cried to the soul to return and avenge itself. Several old women relieved one another in this duty. Occasionally, an old priest approached and addressed the body with a long tirade to the same effect. Once in an hour, perhaps, the widow or mother emerged from the little hut where she sat, and throwing her arms around the corpse wept most piteously, crying to the soul to "come back! come back!"; or, shaking the body violently, she cried: "Wake up! Bahatan! Wake

[12] Called *hapi*. This headdress when thus worn is called *balu*.

up!"[13] During this time, also, until the morning of the third day, an almost constant ceremony was held in the house. Two or three priests relieved one another at long intervals. I have not yet obtained the text of those house ceremonies and can say little about them except that their general purpose was to keep the soul of the dead man, the ancestral souls of the clan, and other friendly spirits always near at hand. This was probably both for present protection and in preparation for the great ceremonies to follow on the third day.

### THE CEREMONIES ON THE HILL.

At earliest dawn on the morning of the third day a party of men proceeded to a small level plateau lying about 400 meters west (toward Lingai) and 90 meters above Bahatan's house. They cut down the tall grass on a place from 60 to 90 meters across, and built a small grass shelter on the south side of this clearing. Around this shelter, and enclosing an 8-meter space in front of it, they planted a circle of bunches of green *runo* stalks with the leaves left on. Soon after sunrise five priests came, bringing with them various of the sacred objects and paraphernalia used in religious ceremonies. Others arrived at intervals during the next hour until the final number of priests was sixteen, including all those of highest rank in Banauol clan. They took up their station within the *runo*-enclosed circle, and after the beginning of the ceremony it was taboo for any other person to step within that circle.

From 8 o'clock until 10 o'clock the people began to gather for the great ceremony of the *munhímûñg,* until more than 2,000 were in the vicinity of the plateau. They came in parties of from 20 to 200 people each, from all the clans at peace with Banauol within half a day's journey about. The procedure in the case of each party was the same as that so well described by Barton in Part III of this paper, and I shall not give it in detail here. The men who were to take part in the burial procession always led, while the women and children followed in a group at the rear. The striped shields, the *bañgibañg,*[14] and the headdresses are well shown in Plates I, II, and IV. The white markings on the shields are painted with a mixture of lime and water. The white bark band of the headdress holds the blood-red *dañgla*[15] leaves in place. Everyone was dressed in his or her finest

[13] *"Bumáñgon-ka! Bahatan! Bumáñgon-ka!"*

[14] See footnote No. 8.

[15] *Dañgla* is *Cordyline terminalis* Kunth, (Liliaceae), and is the most important and most used of the sacred plants of the Ifugao. Large quantities of it are planted on the walls of the rice terraces (See Plates III, VII, and VIII). These spots of crimson color attract every traveler's attention, as they form the most striking ornament on the giant stairways of terraces that run up the mountainsides almost to their very tops.

clothing and ornaments and the parties certainly presented a striking appearance as they slowly wended their way into the valley. At times a dozen of them were in sight, coming from different directions, and the beating of the wooden musical instruments could be heard for miles.

In Central Ifugao the parties do not go to the house of the dead man unless their path leads them by it, but proceed at once to the plateau or hill upon which the ceremony is being held. In the present case, as each party approached the plateau the women and children dropped out and only the men who were to take part in the procession went on. The men trotted with a swinging dance step onto the plateau, playing their *bañgibañg*[16] rapidly, and passing once around the circle of *runo* clumps came to a halt beside it. The leader communicated with the priests within the circle, and they assigned him his position in the procession. Upon learning this the party broke up, the members wandering off singly or in groups to find their assigned places.

In the meantime, since 10 o'clock, the religious part of the ceremony had been in progress. Two hogs and several chickens were necessary for the sacrifice, and on the present occasion one of the hogs was contributed by Lieutenant Gallman and the other by myself. This was eminently proper, for Bahatan had died in our service, and, to the Ifugao, Lieutenant Gallman stood in the relation of his overlord. The chickens, rice, and other things necessary were contributed by the family of the deceased and by Tañggána, his former overlord. The hogs and chickens were placed in the little grass shelter, already referred to, to await the time when they would be needed.

The first ceremony for the securing of vengeance is called *munûbûb*. Two chickens were sacrificed in the ordinary manner, after a short religious ceremony.[17] Their meat was then cooked in one pot and some rice in another. Several pieces of the cooked meat were tied in various places on the roof of the little grass shelter, and others were placed in a small basket which was tied in the top of one of the *runo* clumps near which the priests sat. At the foot of this clump five small wooden bowls were placed, and filled, one with the chicken's blood, two with chicken broth, and two with the rice drink (*bubûd*). All of these articles were carefully watched by the priests from the time they were so placed until high noon, when the ceremony ended. This was to learn the will of an *idu*, or omen spirit which usually manifests itself in the form of a little bird called *pîtpît*.[18] If one or more of these birds comes to eat of the meat or drink of the liquids

[16] Wooden musical instruments, see p. 232.

[17] *Baki*, see p. 233.

[18] *Prionochilus* sp.

in the bowls, it is a very favorable sign. Had that occurred in this case, the hogs would have been sacrificed immediately in the vengeance ceremony and on the following night a party of warriors would have started for Liñgai. However, no *idu* appeared at the ceremony for Bahatan, and to make clear what really did occur it is necessary here to describe briefly a few of the general beliefs regarding the omen spirit and the significance of its appearance at the *munhímûñg* ceremony:

Most of the omens are unfavorable, and whenever an omen spirit appears, its every movement is watched with anxiety. Of special significance are the direction of its flight and the character of its cries. If it flies slowly overhead in any direction away from that of the inimical clan, at the same time uttering a low mournful cry, it is a bad sign; but if it flies rapidly to the rear of the observers, uttering a sharp cry of fright, it is the worst sign of all. Either of these things indicates that vengeance will not be obtained for some time to come, and that any war party sent out at once would surely meet with disaster. Many other things may be learned from the *idu*—but it sometimes happens that none appears before 12 o'clock, as was the case at Bahatan's *munhímûñg*. This is not taken as a bad sign but merely indicates that the time is not ripe and that a series of vengeance ceremonies must be held on the days following the burial.

### THE BURIAL.

At all *munhímûñg*, no matter how the ceremonies on the hill turn out, the burial in no case is delayed—it always begins exactly at noon. The time is determined by the Rice Chief[19] of the clan. The Rice Chief of Banauol is Bundînlan of the village of Ambáliu. At the ceremony for Bahatan he sat with the priests in the *runo*-enclosed circle on the plateau, and shortly after 11 o'clock he removed from his hip-bag five little wooden pegs which he thrust in the ground in a vertical position. From watching the shadows cast by these pegs he was able to determine when the sun had reached the meridian. Even had the day been cloudy he would have guessed the hour with great exactness.

As noon approached, the men who were to take part in the procession sought their assigned positions, and when Bundînlan rose to announce the hour a long line of nearly a thousand men in single file reached from the plateau to a point far beyond Bahatan's house. A few minutes before 12 o'clock, the priests sent eight men down to the house to prepare the body by tying it on a pole in the same manner in which it had been tied when brought home. They also sent several other men to open and prepare the tomb and cut the grass around it.

[19] The Rice Chief is called *tumúnôh* in Central Ifugao and *munlapu* in Kiáñgan Ifugao. In the former area the position is nearly always filled by a man, in the latter either by a man or a woman. The Rice Chief is the astronomer and meteorologist of the clan, in addition to being its leader in agriculture. The *tumúnôh* of Central Ifugao have considerable astronomical knowledge and have evolved an excellent calendar.

Exactly at noon Bundînlan spoke to the priests and they all stood up together, shouting at the tops of their voices: "Attention! ye Deities of the Sky World, for we are about to bury a beheaded man!"[20] This cry was taken up and repeated throughout the whole line of waiting men, and they fairly made the hills ring with their shouts. Six of the highest ranking priests at once left the plateau and went to the house, from which place, after glancing at the body to see that it was all right, they proceeded to the head of the procession. Each of the three leaders carried two spears and wore a peculiar back-basket of the type called *i-nâb-nú-tan*.[21] The three following priests each carried a spear and a shield. They advanced very slowly, dancing all the way a peculiar dance which represented a mimic fight. This was accompanied by much low-voiced muttering and occasional loud cries. About half of the men in the procession carried shields and the other half *bañgibañg*. The tattoo upon the shields and the playing of the wooden musical instruments was kept up all the way from the house to the tomb. For the greater part of the distance the body was carried about midway in the procession, but as they neared the tomb the men carrying it advanced to a position just behind the leading priests. The women, children, and men not taking part in the procession stood in scattered groups and lines on the hillsides and along the walls of the rice terraces, where they could get a good view of the proceedings. The wife and mother of the dead man were the only women in the procession. They followed just behind the body.

Men for whom the *munhimûñg* ceremony is performed are not buried in ordinary graves, but in large tombs called *guñgât*, hollowed out in the mountain-side.

These tombs are from 6 to 8 meters across and about 1 meter high. The roof is supported by pillars of earth or stone which are left at frequent intervals. There are 6 of these tombs in Banauol clan district. The opening is walled up with stone, and in front of each a quick-growing tree called *hanâ'li*[22] is planted. The rate of growth of this tree is known, and it is cut off near the ground each time a burial is made. The people are thus easily able to tell when the last burial was made in that tomb.

The distance from Bahatan's house to the tomb where he was buried is about 3 kilometers, and the procession was fully an hour and a half in reaching its destination. When the leaders had arrived at the place, the procession halted and those in the rear began slowly to disperse.

[20] *"Gópa-gópan dakayun Bagol ad Daya, ta munhimûñg-kami!"*

[21] The appearance of the priest wearing this basket is extremely grotesque. The basket is covered with long black needles made from fern-tree roots, and as the priest stoops in the dance these needles stand erect all over his back like the bristling quills of a porcupine.

[22] Also sometimes called *tuñgób*. I do not know the scientific name.

About twenty of the men immediately behind the leaders advanced and removed their headdresses which were then strung on two short poles, cut from the *hanâ'ti* tree at the mouth of the tomb, and stood up one on each side of the passage which led at a sharp angle downward into the tomb. The body was then brought forward, removed from the shield, and carried into the tomb. The passage was so small that those who entered were forced to crawl on their hands and knees. The body was not wrapped in a death blanket, but was dressed only in an ordinary clout. It was placed in a sitting posture at one side of the tomb, facing Liñ̃gai, and held in position by wooden stakes cut from the *hanâ'ti* tree previously referred to. After everything was prepared two men again walled up the mouth of the tomb.

During all the time that the burial was taking place, and until the wall was almost finished, the widow, mother, and brother of the dead man stood at the beginning of the passage and cried out to him with loud voices. They alternately asked him to come back, and to avenge himself. After everything was finished they quietly went home, where they remained in comparative seclusion during their period of mourning previously described. After the walling up of the mouth of the tomb the poles containing the headdresses were laid over it, and a *tukâb* (wooden spear) stuck in the ground at right-angles to the slope. The people then quietly dispersed, and the *munhímûñg* ceremony was finished.

### THE AFTER-BURIAL CEREMONIES.

Although the *munhímûñg* ended with the burial of the body, the after-burial ceremonies, while not so spectacular nor attended by so great a number of people, were even more curious and interesting. They were of two kinds very different in character,—the *líu-líua* (or ceremonial nights of general license) held on the three nights following the *munhímûñg,* and the vengeance ceremonies held at sunrise on the six successive mornings following the burial.

### THE LÍU-LÍUA.

Before returning home, all of the men of Banauol clan who had marched in the burial procession took a ceremonial bath. The period of enforced continence was now at an end. That night in every village of Banauol there were little ceremonial gatherings of men and women at the houses of the *kadañgyan* (nobility). These gatherings are called *líu-líua,* and there are present at each from ten to forty or fifty guests. The people are invited by one of the nobility, who also provides sufficient *bubûd* (the fermented rice-drink), betel nuts, betel leaves, and tobacco to last throughout the night—for the gathering does not break up until early dawn. The number of men and women is usually about equally divided, and all are young or middle-aged, mostly coming from the nobility

and middle classes. Children and old people do not attend. The gathering is held on the paved place, called *daúlon,* underneath the house, and usually begins at about 8 or 9 o'clock in the evening. The host as a rule sits in the center beside the jar of rice-drink and the baskets or bowls containing the betel nuts, leaves, and tobacco. A small fire of pitch pine, both for light and warmth, is also built near the center. In the earlier part of the evening the women usually gather in a group on one side of the fire while the men sit on the other, but by midnight or after, when all have become warmed with the wine and the fervor of the songs, they mix together freely. No person is responsible for anything that he or she may do at a *líu-líua,* and no enmities or hard feelings are ever retained.[23]

The principal purpose of the gathering is the singing of certain ceremonial songs, and this is kept up during the whole night. The songs are of two distinct types: the *a-ápôx di gîmaiyañg* and the *mun-líu-líua.* The former are of mutual criticism on the part of the men and women, and the latter are of love and war. The latter are sung at all *líu-líua* ceremonies, throughout the year, and are in a curious, secret language utterly different from the spoken Ifugao.[24]

The *a-ápôx di gîmaiyañg* are sung only after the *munhímûñg* ceremony, and never at *líu-líua* held on other occasions. They are in the ordinary spoken language and, unlike most Ifugao songs, are not sung by a leader and chorus but by all the men singing together in one group and the women in another. The following extract from one of these songs was obtained at the house of Kiñggiñgan of Pasnakan, on the second night after Bahatan's burial, and will show their general character. It is given both in the original [25] and in a free translation:

[23] The Ifugaos ordinarily have a very strict moral code, and the crime of adultery is punishable by death, but there is no doubt that formerly general license of every sort was permissible at a *líu-líua.* At the present time improper intercourse is very much frowned upon, and the younger married people will not attend a *líu-líua* where anything improper is liable to occur.

[24] This secret language is used only in certain religious and ceremonial songs, such as the *munhañgal* of the Central Ifugao priests and the *munhûdhûd* harvest song of the Kiáñgan women. It is so different from the spoken language that I have listened to it for hours without being able to recognize a single word, except an occasional proper name. Indeed, the Ifugaos themselves have largely forgotten the meaning of these words. They know the general meaning only, and can not translate it word for word into the spoken language.

[25] *A-ápôx di Gîmaiyañg.*

MEN. *Dakyu hi binabaii,* le-le-û-lin-um-an, *isda-yu giniñga-yu hi nan payo,* le-le-û-lin-um-an.

WOMEN. *Dakyu hi linalaki,* le-le-û-lin-um-an, *ya isda-yu hi wañgwañg di inugâdiu-yu,* le-le-û-lin-um-an.

MEN. *Dakyu hi binabaii,* le-le-û-lin-um-an, *ya e îpîpluk hi payo di giniñga-yu,* le-le-û-lin-um-an.

*A-ápôx di Gîmaiyañg.*

MEN. "Ye the women, *le-le-ú-lin-um-an,* ye eat of the shell-fish ye have captured in the rice-fields *le-le-ú-lin-um-an.*"

WOMEN. "Ye the men, *le-le-ú-lin-um-an,* and ye eat at the river the fish ye have captured, *le-le-ú-lin-um-an.*"

MEN. "Ye the women, *le-le-ú-lin-um-an,* and ye cook upon the walls of the rice-fields the shell-fish ye have captured, *le-le-ú-lin-um-an.*"

WOMEN. "Ye the men, *le-le-ú-lin-um-an,* and (when ye go on a journey) ye eat your clouts upon the path, *le-le-ú-lin-um-an;* and ye do not return to your homes, *le-le-ú-lin-um-an;* and (because of that) your children are weeping, *le-le-ú-lin-um-an.*"

MEN. "Ye the women, *le-le-ú-lin-um-an,* and ye do not go to your sweet-potato fields, *le-le-ú-lin-um-an;* and (because of that) your husband becomes lank and lean, *le-le-ú-lin-um-an;* because he has not eaten of the results of your planting, *le-le-ú-lin-um-an.*"

WOMEN. "Ye the men, *le-le-ú-lin-um-an,* and the meat (ye have obtained at the feasts ye have attended) decays in your hip-bags, *le-le-ú-lin-um-an;* for ye forget to remove it when ye return to your homes, *le-le-ú-lin-um-an;* and there is no meat-food in your houses, *le-le-ú-lin-um-an;* and a stench arises from the meat in your hip-bags, *le-le-ú-lin-um-an.*"

Etc., etc.

These songs of mutual criticism are sung during the first half of the night, and the other class of songs occupy the remainder of the time. The attendance on the second and third nights of the *líu-líua* is not so large as on the first night, and is frequently composed of different people. Considering their character, the conduct of these ceremonies is very orderly. There is seldom enough of the intoxicant to produce much drunkenness, other than the required "joyful" feeling, and there are no public obscenities. In many districts of Central Ifugao these ceremonies are now no more than an ordinary social gathering and *Sängerfest.*

THE VENGEANCE CEREMONIES.

The vengeance ceremonies are very different in spirit and character from those just described, and it was possibly to counteract their frenzied ferocity that the latter were invented. They are called *mungámu-gáman,* and really last for seven mornings, since the one held on the morning of the burial day is essentially the same in purpose as those held on the

WOMEN. *Dakyu hi linalaki,* le-le-ú-lin-um-an, *ya isda-yu nan dalan di wanax-yu.* le-le-ú-lin-um-an; *ya meid idatañgyu bale-yu,* le-le-ú-lin-um-an; *ya han tumáañg-da nan imbabále-yu,* le-le-ú-lin-um-an.

MEN. *Dakyu hi binabaii,* le-le-ú-lin-um-an, *ya meid idatañgyu bînkáan-yu,* le-le-ú-lin-um-an; *ya dîn napigût nan ahauwa-yu* le-le-ú-lin-um-an; *di meid di kanona di bînkáan-yu,* le-le-ú-lin-um-an.

WOMEN. *Dakyu hi linalaki,* le-le-ú-lin-um-an, *ya mapite de dotâg hi butûñg-yu,* le-le-ú-lin-um-an; *addî-kayu ukaton hi bale-yu,* le-le-ú-lin-um-an; *ya meid di isda-yu hi baleyu,* le-le-ú-lin-um-an; *ya humamu hamói di dotâg hi butûñg-yu, le-le-ú-lin-um an.*

Etc., etc.

six following. The true vengeance ceremony is not held until the omen spirit appears with the decree of fate. Should it appear with a favorable decree on the morning of the burial day, vengeance will be obtained very soon; but if on any of the following six days, it is held that vengeance will be obtained in as many months as the number of days waited. Should it not appear at all during these days, it is doubtful if vengeance will ever be obtained.

At the vengeance ceremony for Bahatan the omen spirit appeared at about 7 o'clock on the third morning after the burial, and ate of the meat and blood. Therefore, it was held that vengeance would be obtained within three months. (As a matter of fact this prediction came true.) The ceremonies on the first and second days were the same as those at the *munûbûb* [26] held on the morning of the burial day, except that the time was from sunrise to about 7.30 o'clock instead of from 10 o'clock until noon. Also, from 50 to 100 young men were present who from time to time sang vengeance songs and songs addressed to the omen spirit asking him to come quickly. When the *idu* appeared in the form of a small bird [27] everyone remained silent until it had finished its meal and flitted away in the general direction of Lin͠gai. The priests then all arose and shouted a few words after the departing spirit. The young men returned to their homes, to spread the news, while the priests immediately proceeded to the house of Bukahan (the brother of Bahatan) in the village of Dîmpal, where the two hogs had been taken on the afternoon of the burial day. The most interesting ceremony of the whole series then took place, but as it is described in detail by Barton in Part III of this paper, I will mention it only briefly, putting in the few details in which the Central Ifugao ceremony differs from that of Kiån͠gan Ifugao.

The ceremony was addressed principally to the great deities of the Sky World (*Ad Daya*) and the Upper World (*Ad Kabúnian*), who are the gods of war and fighting. The most important of these deities are: *Manahaut* (the Deceiver), *Amalgo* (the chief of the Sun Gods), *Ambulan* (the chief of the Moon Gods), *Lubog, Pawit, Halan͠gob, Amtalu, Amtilâg, etc.* Various of the priests were possessed by these deities. *Amalgo* speared the pig and *Ambulan* threw himself upon it, drinking the spurting blood until he was pulled away. Several of the priests seized handfuls of the blood and smeared themselves from head to foot. The pig was still living, but was soon killed in the ordinary manner by piercing its heart with a sharpened stick (the *wiwik*).[28] After the hair had been burned off, the body was cut up with scant ceremony and a small portion cooked. The meat was divided among the priests and the near relatives of Bahatan.

[26] Where the chicken meat, blood, broth, and rice-wine were prepared for the coming of the *idu*.

[27] *Pît-pît*, see p. 236.

[28] This is apparently not the custom in Kiån͠gan Ifugao, as there the spear is thrust through the pig's heart, killing it immediately.

One hog was killed in the forenoon and the other in the afternoon of the third day. On that same afternoon a large shallow pit, about 3 meters square and 1 meter deep, was dug on the plateau where the ceremonies of the previous mornings had been held. The ceremonies of the fourth, fifth, and sixth mornings took place around this pit, and were all alike. From two to three hundred young and middle-aged warriors with spears and shields danced a mimic battle and sang songs of vengeance from sunrise until about 7 o'clock. At the same time two old priests sat in the center of the pit, where a small fire was built, and performed a religious ceremony over some of the meat of the hogs killed on the third day. The warriors danced and sang themselves into a frenzy disquieting to look upon. Some women and children who had gone up to the plateau on the fourth morning ran away in fright when the dance reached its height. After this ceremony the men returned home thoroughly exhausted and did little or no work on that day.

### CONCLUSION.

The completion of the vengeance ceremonies likewise completes the observances connected with the *munhímũñg* burial. The people believe that the souls of men buried by this ceremony lead most unhappy lives. They are forced to wander about, for a time at least, among the war gods and great evil deities of the Sky World (*Ad Daya*) and the Upper World (*Ad Kabúnian*). It is far from being an honor to have one's head taken. In fact, to the Ifugao, it is the greatest of all misfortunes.

## PART III. THE BURIAL OF ALIGÚYUN.[29]

### ALIGÚYUN'S DEATH AT KIÁÑGAN.

Aligúyun, of the district of Nagakaran in Kiáñgan Ifugao, was a soldier in the constabulary company stationed at Kiáñgan. He was killed while on duty, May 2, 1910, by a prisoner in the guardhouse who had secretly obtained a weapon. This prisoner had determined to escape and would have killed anyone who barred his way had he not been immediately shot by one of the other soldiers.

The killing of Aligúyun was therefore not done for revenge; in fact, his murderer probably did not know who he was nor where he was from. However, it so happened, that the prisoner himself was from the district of Kurûg, which is about 10 or 12 kilometers distant from Nagakaran, the home of Aligúyun. Old feuds existed between nearly all the clans in this area, and Nagakaran and Kurûg were not exceptions.

Since the suppression of head-hunting in Ifugao, it has become a

[29] By Roy Franklin Barton.

general custom to accord the *munhímûñg* burial to all persons killed by members of inimical clans, and this custom was followed in the case of Aligúyun. I witnessed only the ceremonies of the third day, and the following narrative of the events of that day was written shortly after their occurrence.[30]

### THE ASSEMBLING OF THE PEOPLE.

On the third day after Aligúyun was killed, the principal funeral ceremonies took place. To these ceremonies came a number of people from their *rancherias*,[31] the party of each *rancheria* being led by relatives of the dead man—some of them very distant relatives.

Nagakaran, the *rancheria* of Aligúyun, was until quite recently very unfriendly to Kiáñgan, where I live. However, Aligúyun had some kin in Kiáñgan and these, together with their friends, went to the funeral. Their shields, as well as the shields of all who attended, were painted with white markings, some taking the conventional form of men, some of lizards, and some were zigzag. (Plates I and II, fig. 2.) Each man who attended had a headdress made of the leaf petiole of the betel-nut tree and the red leaves of the *dáñgola*[32] plant. To each leaf were attached pendants of feathers. Mourning bands, made of strips from the same petiole, were tied around both arms and legs, and in some cases a pendant *dáñgola* leaf was attached to each band. Every man was dressed in his best clout and the women in their best skirts and in all their finery of gold ornaments and agate necklaces.

Nagakaran village is one of several in a very large valley (Plate VII). When I reached a point in the trail commanding this valley there could be seen coming from each of the various villages a procession wending its way slowly toward Aligúyun's home. From the time when it came within sight of the house, which was sometimes at a distance of from 2 to 3 kilometers, each procession danced its way, beating on the striped shields with drum sticks, and on the *bañgibang*, a wooden stick made of hard resonant wood[33] coated with chicken blood and extremely old.

[30] At the request of Major Willcox, United States Army, who was in Kiáñgan at the time of Aligúyun's death. Some corrections and minor changes have been made in the text.

[31] The word *rancheria*, as used in the following pages and as commonly used by the American officials in Ifugao, designates what Beyer terms *clan district* in Parts I and II of this paper.

[32] The Kiáñgan Ifugao name for *Cordyline terminalis* Kunth, (Liliaceae), previously described.

[33] The *bañgibañg* is usually made of *tú-ol*, an extremely heavy dark-red wood. The specific name of *tú-ol* is *Bischofia javanica* Bl. (*Euphorbiaceae*). There are both wild and cultivated varieties.

This stick is curved slightly, is about 60 centimeters long, and is held in one hand suspended by a rattan string so that the vibrations are not interferred with. It is beaten with a drum stick as is also the shield. The *gañgha*, or bronze gong, is never used in the funeral of a beheaded man.

Each of the two head men of each procession carried two spears. Behind the head men came a man carrying spear and shield. The two men in front faced the oncoming procession, stepping most of the time backward, and making thrusts toward the bearer of the spear and shield. The latter returned the thrusts and executed various "fancy steps," the whole being a dance which in some respects resembles one of the head-dances of the Bontok Igorot. From the high place on the trail all moved slowly along the walls of the rice terraces toward the central village. The columns appeared in the distance like gigantic centipedes or files of ants. It usually takes an hour for such a procession to cover 1 mile. It was a still morning and the beating of shield and stick could easily be heard across the wide valley.

Arriving at Aligúyun's house we found him sitting on a block facing the sun, and leaning against his shield which was supported by the side of the house. The body was in an advanced state of decomposition. It was swollen to three times its living girth. Great blisters had collected under the epidermis which broke from time to time, a brownish-red fluid escaping. The spear wound in his neck was plugged by a wooden spear-head. In each hand Aligúyun held a wooden spear. No attempt whatever had been made to prevent decomposition of the body or the entrance to it of flies. Two old women on each side with penholder-shaped loom-sticks a half meter long continually poked at Aligúyun's face and the wound to wake him up. From time to time they caught the gruesome head by the hair and shook it violently shouting:

Who-oo-oo Aligûyun, wake up! Open your eyes. Look down on Kurûg.[34] Take his father and his mother, his wife and his children, and his first cousins and his second cousins, and his relatives by marriage. They wanted him to kill you. All your kin are women. [They say this in order to deceive Aligûyun into avenging himself.] They can't avenge you. You will have to avenge yourself. There is *ordên*[35] now; no one can kill them but you. Take them all. You are to be pitied. You will be lonesome. Accompany their spirits[36]. If they eat, eat with them. If they sleep, sleep with them. If they go to get water, go with them. If they go to get wood, turn the ax into their bodies. If they go on a journey, push them over a precipice. So, you will have com-

[34] Kurûg being the *rancheria* from which came Aligûyun's murderer.

[35] Law; referring to the establishment of American authority and the prohibition of head-hunting.

[36] The spirits of the kin of the murderer.

panions there in the Sky World, you will have someone to help you get wood and water.[37]

This calling on Aligúyun's soul never ceased. When one old woman grew hoarse, another took her place. As the procession came to the house it filed past Aligúyun and its leaders stopped and shouted words to the same effect as those that the old woman kept shouting. The key-note of the whole ceremony was vengeance. It is true that the man who had killed Aligúyun was himself killed, but the people of a *rancheria* regard themselves as being about the only really valuable people in the world, and hold that three, four, or five men of another *rancheria* are not equal to one of theirs.

### THE CEREMONIES ON THE HILL.

Toward noon the people told me[38] that they were going to perform the ceremony which looked toward securing vengeance for Aligúyun's death. They went to a little hillock some distance from any house, where a grass shelter had been built for protection from the piercing rays of the noonday sun. Two pigs were provided there, one of which was very small. Only the old men were permitted to gather around the pigs and the rice wine and the other appurtenances of the ceremony. The ceremony began by a prayer to the ancestors, followed by an invocation to the various deities. The most interesting and principal one of the ceremonies was the invocation of the celestial bodies who are believed to be the deities of War and Justice. Manahaut (the Deceiver) a companion of the Sun God was first invoked. The priests cried:

"Who-oo-oo, Manahaut! look down! Come down and drink the rice wine and take the pig. Don't deceive us. Deceive our enemies. Take them into the remotest quarters of the Sky World; lock them up there forever so that they will not return. Vengeance for him who has gone before." Then an old priest put his hands over his forehead and called: "Come down, Manahaut of the Sky World." Manahaut came and possessed him causing him to call out: "Sa-ai! Sa-ai! I come down Manahaut; I drink the rice wine; I will deceive your enemies, but I will not deceive you."[39]

[37] It is somewhat strange, this idea of a soul's associating with the souls of his enemies, whose death he has brought about. However, throughout the Ifugao's religion we find evidences that the soul is conceived as losing earthly affections and enmities, but never earthly appetites and desires.

[38] Nagakaran being the *rancheria* that speared and nearly killed my predecessor, Mr. Wooden, I explained my presence to the people there by saying that the soldier being an agent of our government was in a way a relative of mine, and that I had come to assist in the last rites and ceremonies due him. The explanation was a perfectly natural one to the people and they treated me with the greatest courtesy and helped me to see whatever was to be seen.

[39] "Deceive" in the sense of "Cause to fall into danger or ambush, possessed by the assurance of safety."

The priest who was possessed jumped up and with characteristic Ifugao dance step, danced about the rice-wine jar, and about the pig. Quickly there followed him a priest who had called Umalgo, the Spirit of the Sun, and who had been possessed by that deity. Manahaut danced ahead of Umalgo to show him the pig, and to urge him on. Umalgo seized a spear, danced about the pig two or three times, then stepped over to it and with a thrust, seemingly without effort, pierced its heart. The priests started the blood-thirsty cry which was taken up by the hundreds of high-wrought barbarians standing round: "So may it be done to our enemies of Kurûg."[40] The blood spurted out of the pig's side and there quickly followed a priest who had been possessed by Umbulan, the Spirit of the Moon, who threw himself on the pig and drank its blood. He would have remained there forever, say the people, drinking the pig's blood had it not been for the fact that one of the Stars, his son, possessed a priest and caused him to dance over to Umbulan, catch him by the hair, and lead him from the pig.

Following these ceremonies other priests came, possessed by various Spirits of the Stars, to cut off the pig's feet and head. And after each event, the cry issued from hundreds of throats: "So may it be done to our enemies." Next came the cutting up of the pig, to cook it in the pots. The blood that had settled in its chest was carefully caught; it was used to smear the *bañgíbañg*[41] and the *hipag*.

The *hipag* are interesting. (See Plate IX.) They are little images of men, pigs, dogs, chickens, and ducks. The spirits that dwell in them help men to take heads. The *hipag* are made of wood, and are about 15 to 20 centimeters high. When an Ifugao goes on a head-hunting expedition he takes the images in his head-basket together with a stone to make the enemy's feet heavy, so that he can not run away, and a little wooden stick in representation of a spear, to the end of which is attached a stone. This last is to make the enemy's spear strike the earth so that it shall not strike him.

As the pig was being put in the pot to be cooked for the priests who had performed the ceremony, some unmannerly young fellow started to make away with one piece of the flesh. Immediately there was a scramble for pork which was joined by some three or four hundred Ifugaos from all the different *rancherias*. Every man there (I think that there were over 1,000 who attended the ceremony) leaped for his spear and shield. The people who had come from Kiañgan rushed to where I was and took their stand in front of and around me, and told me to stay there, and that they would protect me from any harm; all of which, as may be supposed, produced no trifling amount of warmth in my feelings toward them. Fortunately nothing came of the scramble.

[40] *"Batna kana okukulan di búhol-mi ûd Kudûg."*

[41] *Bañgíbañg*, wooden musical instruments, see p. 244.

I have no hesitancy in saying that two or three years ago, before Governor Gallman had performed his truly wonderful work among the Ifugaos, this scramble would have become a fight in which somebody would have lost his life. That such a thing could take place without danger was incomprehensible to the old women of Kiañgan, who doubtless remembered sons or husbands, brothers or cousins, who had lost their lives in such an affair. With the memory of these old times in their minds they caught me by the arms trying to drag me off with them and said: "Balton [Barton], come home; we don't know the mind of the people. They are likely to kill you." When I persisted in refusing to miss the rest of the ceremony they told me to keep my revolver ready.

Looking back on this incident I am sure that I was in little or no danger, but must give credit to my Ifugao boy who attended me for having the wisest head in the party. This boy immediately thought of my horse which was picketed near, and ran to it, taking with him one or two responsible Kiañgan men to help him watch and defend it. Had he not done so some meat-hungry, hot-headed Ifugao might easily have stuck a bolo in its side during the scramble and attendant confusion. Immediately some 500 or more Ifugaos would have been right on top of the carcass and hacking at it with their long knives, and it probably would have been impossible ever to find out who gave the first thrust.

The priests who had performed the ceremony, after the people had quieted somewhat, began scolding and cursing those who had run away with the meat. Finally, they managed to prevail upon the meat snatchers to bring back three small pieces about the size of their hands, from which I concluded that Ifugao is a language admirably adapted to stating a situation clearly,—for I know how hungry for meat these Ifugaos become.

Three old men stuck their spears into a piece of meat and began a series of long stories the theme of which was some past confusion of enemies. At the conclusion of each story they said: "Not there but here; not then but now." The mere telling of these stories is believed to secure a like confusion and destruction of the enemies of the present. When this ceremony had been completed each old man raised his spear quickly in order to secure the impaled meat for himself. If he had not done this it would have been snatched by those who were waiting for that purpose, and made the object of another scramble. In one case one of the old men just missed ripping open the abdomen of the man who stood in front.

### THE BURIAL.

The ceremonies on the hill being finished, the people made an attempt to assemble by *rancherias* and to file along the trail to bury Aligúyun. Nagakaran *rancheria* took the lead. As the procession came near the grave the men took off their headdresses and strung them on a long pole which was laid across the trail. A Nagakaran man went to where Aligúyun was sitting, picked him up, carried him to the grave, and placed him in a sitting posture facing Kurûg. Aligúyun was not wrapped in a death blanket as corpses usually are. His body was neglected in order to make him angry and incite him to vengeance.

The grave was a sepulcher dug out of a bank. It was walled up with stones after Aligúyun was placed in it and an egg thrown against the tomb whereupon the people yelled: "So let it happen to our enemies of Kurûg." [42] The poles on which were strung the headdresses were taken away and hung over the door of Aligúyun's house. After this the people dispersed to their homes. On the way home they stopped at a stream and washed themselves, praying somewhat as follows:

Wash, water, but do not wash away our lives, our pigs and our chickens, our rice, and our children. Wash away death by violence, death by the spear, death by sickness. Wash away pests, hunger, and crop failure, and our enemies.

[42] "*Batna kana okukulan di búhol-mi ad Kudûg.*"

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

# ILLUSTRATIONS.

PLATE I.

FIG. 1. Kalatoñg (x), the chief of Kambulo clan, with a group of Kambulo people. (Photograph by Beyer, Banaue, September 12, 1907.)

2. Five of the men who marched in the funeral procession at the burial of Bahatan. Note the headdresses, armlets, and leglets of white bark; also the striped shield and the four *bañgibañg*. (Photograph by Beyer, April 3, 1908.)

PLATE II.

FIG. 1. Kalatoñg's head, on the third day after he was beheaded. (Photograph by Beyer, at Banaue in January, 1908.)

2. A man who took part in the procession at the burial of Bahatan. (Dumapis of the village of Bokos, Banauol). Note the painted shield. This man wears a turban in place of the usual bark headdress. (Photograph Beyer, April 3, 1908.)

PLATE III.

Southern half of the clan district of Banauol, where Bahatan lived. Battañg's house is shown on hill to the left, just above the largest rice terraces. The tomb where Bahatan was buried is in the mountainside behind the same hill. (Photograph by Beyer, February 28, 1911.)

PLATE IV.

FIG. 1. The body of Bahatan as prepared for the ceremonies at the house. The head has been fastened in position on the severed neck. Note the *kînillo* on the breast, the shield behind the body, and the wooden spear standing beside each arm. (Photograph by Beyer, April 1, 1908.)

2. A part of the procession at the burial of Bahatan. The people in the foreground, and on the hill to the right of the procession, are spectators. (Photograph by Beyer, April 3, 1908.)

PLATE V.

Three Ifugao priests of Banauol clan. From left to right they are: Tañggana of Añgâdal, the overlord of Bahatan mentioned in the text; Pītpitúñgai of Ulditañg, a very wealthy *kadañgyan* but of low rank as a priest; Bulañgon of Panañgan, the chief priest of Banauol clan. (Photograph by Barton, Banaue, 1911.)

PLATE VI.

FIG. 1. A Central Ifugao woman of the serf class. (Ináyao of the village of Pasnakan, Banauol.) Note the coarse garments made of woven bark fiber. (Photograph by Worcester, April, 1903.)

2. Three Central Ifugao women of Kambulo and Banauol clans. The woman in the center was the wife of Battañg, and the one on the right a relative of Kalatoñg. (Photograph by Beyer, Banaue, 1906.)

3. A typical Kiáñgan Ifugao man—Dulúdul of the village of Baai, Kiáñgan. (Photograph by Beyer, 1906.)

PLATE VII.

The clan district of Nagakáran, the home of Aligúyun. (Photograph by Martin, 1909.)

PLATE VIII.

FIG. 1. Kiáñgan, Ifugao, looking east from the lieutenant-governor's house at Kiáñgan. The black dots in the terraced fields in the foreground are mounds of earth on which cotton is grown. (Photograph by Haskell, 1909.)

2. The central village of the clan district of Búrnai, in Kiáñgan Ifugao. (Photograph by Beyer, 1907.)

PLATE IX.

Some Ifugao religious objects used in this ceremony: (*a*) The basket in which the *hipag* of a Kiáñgan Ifugao family are kept; (*b*) The skull of a crocodile. This skull and one other are practically the common property of Kiáñgan clan. It has the same power as the *hipag*. The crocodile is an Ifugao deity; (*c*) The *hipag*, the *muliñg* (hard, heavy stones), and the stick with a stone tied to one end, that belong to the family of Manáyao, a Kiáñgan priest. All of these objects are encrusted with human blood and the blood of sacrificed animals, and are of extreme age. (Photograph by Barton, Kiáñgan, 1911.)

PLATE X.

FIG. 1. An old priest of Kiáñgan. The blanket over his shoulder is of the variety called *hapi*, mentioned in the text. (Photograph by Martin, 1909.)

2. A Central Ifugao priest—Dolmug, of Lugu clan. (Photograph by Martin 1909.)

3. A typical Central Ifugao man—Kulúñgai of the village of Pasnakan, Banauol. (Photograph by Beyer, Banaue, 1905.)

FIG. 1.

FIG. 2.

PLATE I.

FIG. 1.

FIG. 2.

PLATE II.

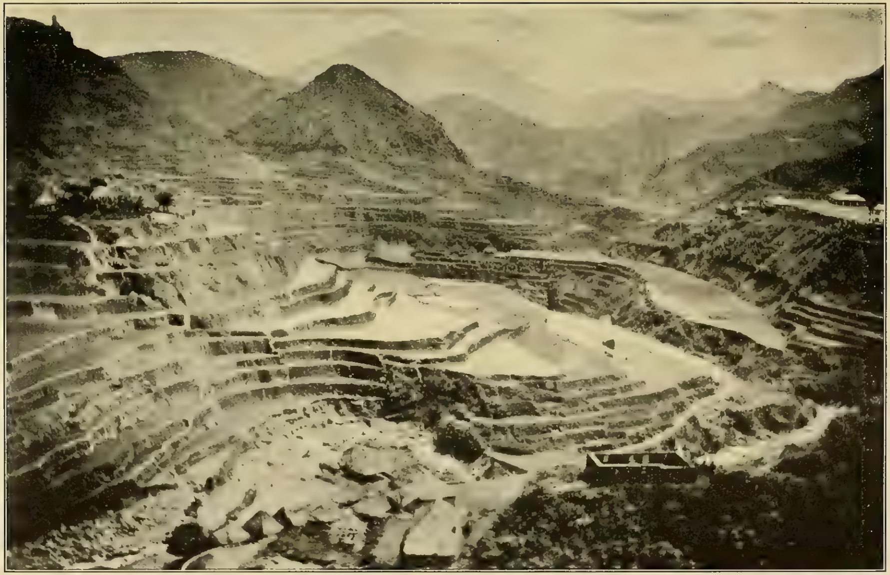

PLATE III.

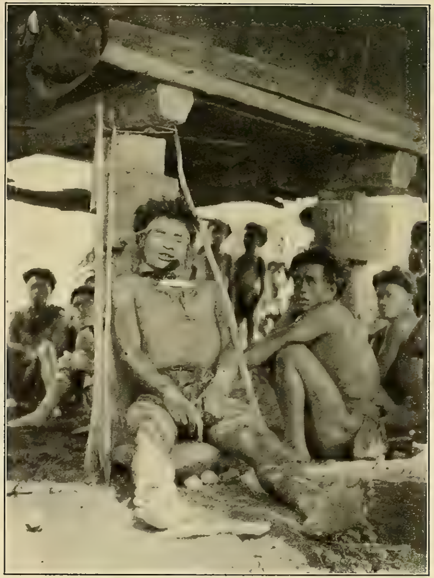

FIG. 1.

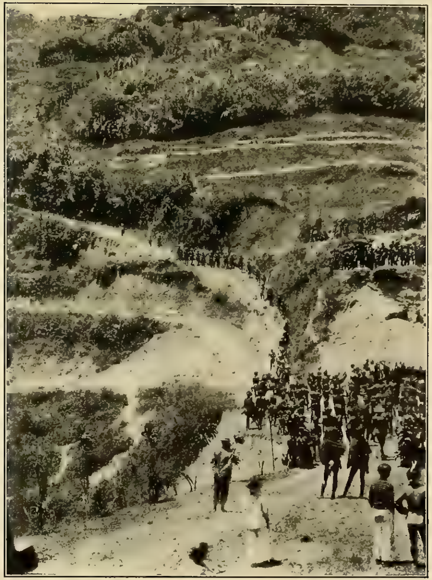

FIG. 2.

PLATE IV.

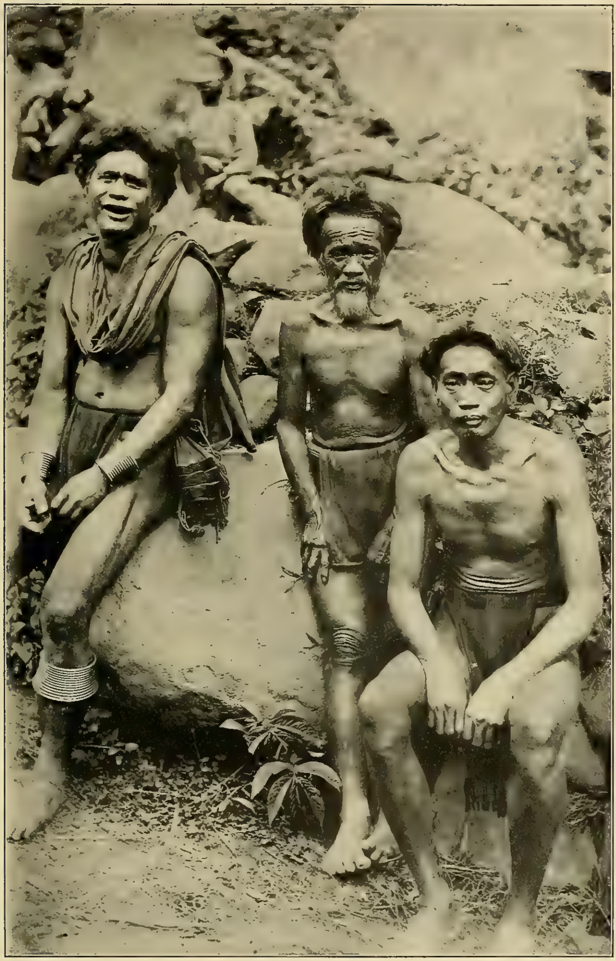

PLATE V.

FIG. 1.

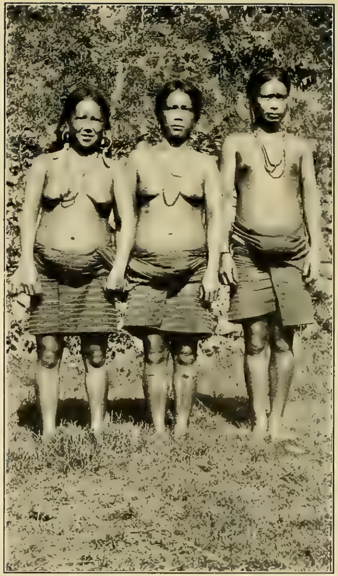

FIG. 2.

FIG. 3.

PLATE VI.

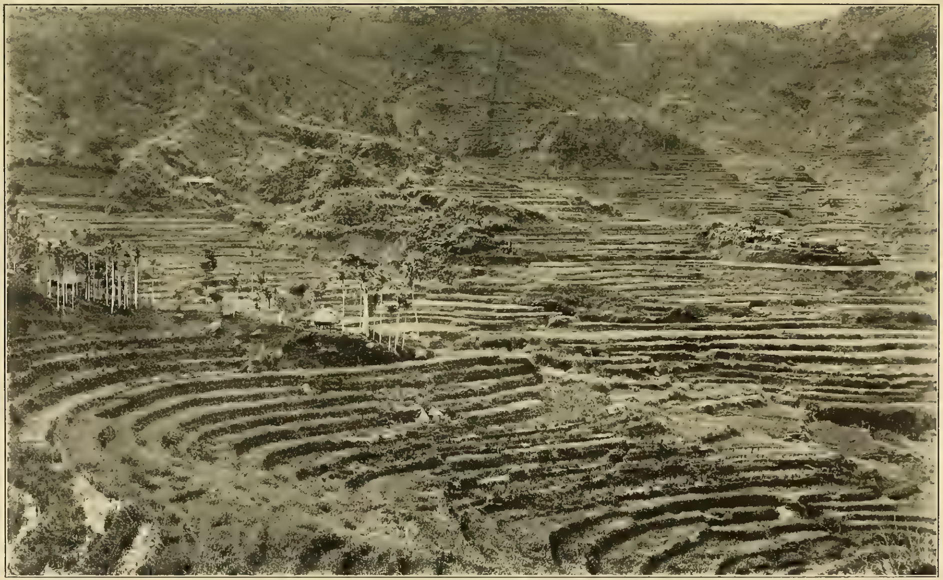

PLATE VII.

FIG. 1.

FIG 2.

PLATE VIII.

PLATE IX.

FIG. 1.

FIG. 2.

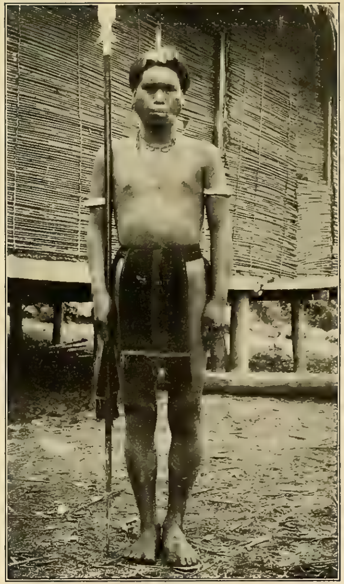

FIG. 3.

PLATE X.

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# A CHECK-LIST AND KEY OF PHILIPPINE SNAKES.

By LAWRENCE EDMONDS GRIFFIN.[1]

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It is twenty-five years[2] since a list of Philippine snakes has been published. During this time Boulenger's[3] monograph has appeared and the systematic position of many species has been so changed as to limit the use of Boettger's list. A considerable number of species has also been added to the fauna of the Philippines since the appearance of the "Catalogue of Snakes."

The object of the present paper is not only to present a complete list of the ophidian fauna of the Philippines so far as it is now known, but also to present this information in such a form that it can be used by persons who are interested in their local animals. For this reason the list of species is arranged in the form of a key, in which external characters are used to distinguish the species, so far as is possible. The experience of the author indicates that snakes not heretofore recorded from the Philippines, and even new species, may still be met with in any locality. As a large part of the Philippines is still in a zoölogically unexplored condition, considerable additions to the herpetological fauna may be expected. Two species not previously recorded from the Philippines are included in this paper; namely, *Xenopeltis unicolor* Reinw. and *Zaocys carinatus* Günther. The occurrence of these species in Palawan again calls attention to the close relationship of the faunæ of that island and Borneo.[4]

In the following list only definite localities usually are given, references to "Philippines" being omitted unless there is no more exact locality known. The classification used in this list is that of Boulenger,

[1] Associate professor of zoölogy, University of the Philippines.

[2] Boettger, Oskar, Aufzählung der von den Philippinen bekannten Reptilien und Batrachier. *Bericht über die Senck. Naturf. Ges.* (1886), 91–134.

[3] Boulenger, George Albert, Catalogue of Snakes in the British Museum, (1893–96), 1–3.

[4] Boulenger, G. A., on the Herpetological Fauna of Palawan and Balabac. *Ann. & Mag. Nat. Hist.* (1894), VI, 14, 81–89.

although several recent changes in generic and family names have been followed. As a matter of course, Boulenger has also largely been drawn upon for the structure of the key. The author will be glad to communicate with any residents of the Philippines who are interested in making collections of reptiles and frogs. Snakes are easily preserved in either alcohol (strong) or 10 per cent formalin, if a number of slits are made in the abdomen. If the abdomen is not thoroughly opened the inner tissues decompose before the preserving fluid can penetrate the skin. Lizards require a single abdominal incision.

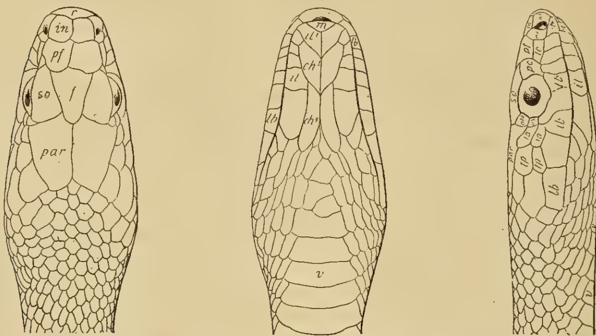

FIG. 1.—Head of *Dendrelaphis cœrulcatus* Griffin: *ch*, chin shield; *f*, frontal; *il*, inferior labial; *in*, internasal; *lb*, superior labial; *lo*, loreal; *m*, mental or symphysial; *n*, nasal; *par*, parietal; *pf*, præfrontal; *po*, præocular; *pto*, postocular; *r*, rostral; *so*, supraocular; *ta*, anterior temporal; *tp*, posterior temporal; *v*, ventral. (Drawing by T. Espinosa.)

## Family TYPHLOPIDÆ.

Small worm-like snakes living under fallen grass or leaves, or burrowing in the ground. Incapable of harm. Head not distinct from body; eyes reduced to vestiges which are covered by shields; no teeth in the lower jaw or on the palate; no enlarged ventral scales; tail very short, and pointed, color generally dark brown .......... Genus **Typhlops**.

$a^1$. Snout rounded; nostrils lateral.

$b^1$. Præocular in contact with second and third labials.

$c^1$. The nasal cleft (i. e. the fissure dividing the nasal shield) proceeding from the præocular .......... **Typhlops braminus** (Daudin).

Manila (*Gray, A. Duméril*); Daraga (*Peters*); Paracale (*Peters*); southern Mindanao (*J. G. Fischer*); Negros (*Boulenger*); Manila, Malabon, Mindoro, Samar (*Bureau of Science collection*). A most widely distributed snake, occurring in all southern Asia, the Malay Archipelago, the Ladrones, Madagascar, East and South Africa.

$c^2$. The nasal cleft proceeding from the second labial.. **Typhlops jagori** Peters.

Mount Isarog, Luzon (*Peters*). Not known from any other locality.

$b^2$. Præocular in contact with the third labial only.

$c^1$. Thirty scale-rows around the body............ **Typhlops ruficauda** (Gray).
Daraga and Paracale (*Peters*). Found only in the Philippines.

$c^2$. Twenty-six scale-rows around the body............ **Typhlops ruber** Boettger.
Samar (*Boettger*). Only the type specimen recorded.

$a^2$. Snout with a sharp horizontal edge; nostrils inferior.

$b^1$. Tail from 2 to 2.5 times as long as broad............ **Typhlops olivaceus** (Gray).
Samar (*Peters*). Found also in the Moluccas and in northwestern Australia.

$b^2$. Tail 4 to 5 times as long as broad............ **Typhlops cumingii** (Gray).
Philippines (*Gray*). Not recorded elsewhere.

## Family BOIDÆ.

Large snakes; with vestiges of hind limbs usually ending in a claw-like spur, which is visible on each side of the vent. Teeth in both jaws; 65 to 80 longitudinal rows of scales; ventral scales transversely enlarged. Represented in the Philippines by only 1 species. Not poisonous. Light brown, with large rhomboidal markings of dark brown to black. A black line along the middle of the head and on each cheek............ **Python reticulatus** (Schneider).

Luzon (*Peters*); Laguna, Polillo, Palawan (*Bureau of Science collection*). Found throughout Burma, Indo-China, the Malay Peninsula and Archipelago.

## Family ZENOPELTIDÆ.

This family consists of a single species. Teeth are found in the premaxillæ, as well as in maxillæ, palatines, and mandible. The dentary bone is movably attached to the end of the articular.[5] Teeth small and numerous in both jaws (33 to 38). Body cylindrical and thick; tail short, about one-tenth of the total length; scales in 15 rows, smooth and highly iridescent, dark brown with lighter edges on the back and sides, white below; head small, flattened, not distinct from neck, snout rounded; eyes small, pupil vertical; easily distinguished from other Philippine snakes by the presence of an unpaired interparietal scale, between 4 parietals. Not poisonous............ **Zenopeltis unicolor** Reinhardt.

Iwahig, Palawan (*Bureau of Science collection*). Previously found in the Malay Peninsula, Borneo, Celebes, and Java.

## Family COLUBRIDÆ.

### Series A. *Aglypha.*

All the teeth solid, without grooves. Non-venomous.

$a^1$. Scales not imbricate, very small and numerous; no enlarged ventral shields; body and tail compressed, with a ventral fold; aquatic.

Subfamily **Acrochordinæ**.

Only one species is recorded from the Philippines.

Olive to black, with light transverse bands or rings. Found from southern India to New Guinea. Very common in Manila Bay and the Pasig River............ **Chersydrus granulatus** (Schneider).

Manila (*Peters, Steindachner*); Los Baños, Cabasao, Santik,

[5] That the arrangement of these bones is peculiar can be noted without dissection, as the body of the mandibular ramus can be felt nearer the middle line of the lower jaw than the dentary, and in a position markedly different from its position in other snakes.

Luzon (*Peters*); Manila Bay (*Boulenger*); Bantayan and Samar (*Bureau of Science collection*).

$a^3$. Scales imbricate, large ventral shields, head covered by regular scales.................. Subfamily **Colubrinæ.**

*I*. Hypapophyses [6] present on the vertebræ of the posterior fifth of the trunk.

$a^1$. Dentary bone of mandible loosely attached to the apex of the articular, and freely movable upon it; teeth very numerous and closely set, equal, 30 to 50 in each jaw; no interparietal shield. Length, 490 millimeters. Black above, with a white streak on each side. White below, with a black spot on the outer end of each shield.

**Polyodontophis bivittatus** Boulenger.

Palawan (*Boulenger*). Only the type specimen known.

$a^2$. Dentary bone not, or but slightly, movable on the articular.

$b^1$. Posterior maxillary teeth longest (18 to 40 in all), [7] mandibular teeth sub-equal; eye moderate or large with round pupil; a pair of internasal shields. Scales generally keeled.

Genus **Natrix.**

$c^1$. Maxillary teeth not more than 30, the last 2 or 3 abruptly enlarged.

FIG. 2.—Upper figure; vertebra with a hypapophysis projecting from the lower side of the centrum. Lower figure; vertebra without hypapophysis. (From Boulenger.)

[6] To note the presence or absence of the hypapophyses it is necessary to make a slit in the posterior fifth of the abdomen; by pushing the viscera aside and bending the backbone downward the ventral surfaces of the vertebræ may be examined. If hypapophyses are present they appear as median ventral processes of the vertebræ.

[7] As the characters of the maxillary teeth are most important in classifying snakes, it is necessary that they should be determined without mistake. The method described by Stejneger, Herpetology of Japan and Adjacent Territory, page 258, is most useful. "The examination of the dentition must be made very carefully in order to avoid mistakes. The safest way is probably to dissect out one of the maxillary bones. This can be done very easily by running the point of a sharp knife between the supralabials and the underlying bone, cutting the tissue along the whole length of the latter. By forcing the point of the knife over the upper edge of the bone in the region of the eye the bone can be easily lifted up and the connecting ligaments severed. The adherent tissue may be carefully removed, though in most cases it is sufficient to let it dry. The teeth can now be examined conveniently. Care must be had not to mistake the space left by a lost tooth for a natural interval; if a tooth has fallen out, a distinct pit or depression is left on the alveolar edge of the maxilla. In counting the teeth the second inner row of loose teeth which are only the reserve teeth must not be taken into consideration. If the specimen is so hardened that it is difficult to open the mouth it should not be forced open by prying, a procedure apt to ruin the teeth and break the lower jaw, but the thick muscle at the corner of the mouth closing the jaws should be cut through on both sides. If properly done the specimen need show no outward sign of mutilation. The maxilla after being dissected out and cleaned should be placed in a small glass tube or vial and provided with the same number as the snake, kept in the same bottle, or separately together with other preparations of the same kind."

$d^1$. Head moderately elongate, not distinct from neck.

$e^1$. A single anterior temporal. "Greenish or brownish olive, with more or less distinct black spots or reticulated cross-bars intersected by two yellow longitudinal bands, which are best marked posteriorly." (Boulenger) .......................... **Natrix stolata** (Linnæus).

Calumpit, Bulacan Province (*Peters*). Widely distributed, from Ceylon to the Himalayas and the Malay Archipelago.

$e^2$. Two anterior temporals.

$f^1$. Internasals shorter than præfrontals; outer row of scales feebly keeled. Yellowish brown, with darker stripes and spots. Belly white or yellowish, with numerous round, black dots.

**Natrix spilogaster** Boie.

Negros (*Boulenger*); Palawan (*Boulenger*); Manila (*Jan*); Albay (*Peters*); Bataan (*F. Müller*); southern Mindanao (*J. G. Fischer*); Manila and vicinity, Polillo, Limay, Camiguin[3] (*Bureau of Science collection*). Occurs in the Philippines only.

$f^2$. Internasals as long as præfrontals; all scales strongly keeled. Brown or greenish above, with indistinct darker cross-bars; frequently with a series of light vertebral spots; yellowish white below, with few or no dark dots.... **Natrix chrysarga** Boie.

Palawan (*Bureau of Science collection*). Common in Palawan, which is the only island of the Philippines in which this widely distributed snake is found. Elsewhere, found in the eastern Himalayas, Assam, Burma, southern China, the Malay Peninsula, Sumatra, Borneo, and Java.

$d^2$. Head short, very distinct from neck.

$e^1$. Scales in 17 rows. Dark brown above, with a yellowish vertebral stripe, and a white stripe on each side.. **Natrix auriculata** Günther.

Loquilocun, Samar (*Peters*); Mindanao (*F. Müller*); southern Mindanao (*J. G. Fischer*); Pasananca (*Challenger*). Confined to the Philippines.

$e^2$. Scales in 19 rows.

$f^1$. Subcaudals 96 to 101. Olive above, vertebral line lighter.

**Natrix crebripunctata** (Wiegmann).

Philippines (*Günther*). Restricted to the Philippines.

$f^2$. Subcaudals 66 ................................................ **Natrix lineata** (Peters).

Loquilocun, Samar (*Peters*). Known only from the Philippines.

$c^2$. Maxillary teeth 35 to 40, the posterior ones but slightly enlarged; eye very large, body very slender. Olive above, with black spots and two series of yellowish spots; yellowish beneath, with numerous large black dots ................................................ **Natrix dendrophiops** (Günther).

Zamboanga (*Challenger*); Mindanao (*F. Müller*); Agusan River Valley, Mindanao (*Bureau of Science collection*). Known only from the Philippines.

$b^2$. Maxillary teeth subequal, 20 to 35; pupil vertically elongated; snout pointed. The genus is Philippine exclusively......... Genus **Oxyrhabdium**.

[3] Camiguin, throughout this paper, refers to the island of that name in the Babuyanes, north of Luzon.

$c^1$. Eight upper labials, fifth and sixth entering the eye. Reddish brown above, yellowish below.

**Oxyrhabdium modestum** (Duméril et Bibron).

Luzon (*Günther*); Samar (*Peters*); Dinagat (*Boulenger*); Mindanao (*F. Müller*); Samar and Mindanao (*Bureau of Science collection*).

$c^2$. Seven upper labials, fourth and fifth entering the eye. Colors like those of the preceding species.............. **Oxyrhabdium leporinum** (Günther).

Luzon (*Boulenger*).

$b^3$. Posterior maxillary and mandibular teeth smallest; enlarged anterior maxillary teeth separated from the other teeth by a short space; scales equal, smooth, with apical pits; nostril between 2 nasals, pupil round. Dark brown above. Belly white with triangular brown spots along each side. A genus of 1 species, which is found only in the Philippines.

**Cyclocorus lineatus** (Reinhardt).

Manila (*Jan*); Daraga (*Peters*); Mindanao (*F. Müller*); Occidental Negros; Benguet, Laguna, Bataan, and Tarlac Provinces, Luzon; Polillo (*Bureau of Science collection*).

*II*. Hypapophyses absent in the posterior dorsal vertebræ, the lower surfaces of which are smooth.

$a^1$. Anterior maxillary and madibular teeth strongly enlarged; posterior maxillary teeth increasing in size; anterior maxillary teeth separated from the rest by an interspace .............................................. Genus **Ophites**.

$b^1$. A præocular, separating the eye from the præfrontal.

$c^1$. Nasal single. Three series of alternating black spots on the back; brown below .............................................. **Ophites tesselatus** (Jan).

Manila (*Jan*). Recorded from the Philippines only, with Manila as the only definite locality.

$c^2$. Nostril between 2 nasals. Dark brown above, with light yellow lips and collar. Yellowish below. A common snake about Manila.

**Ophites aulicus** (Linnæus).

Manila (*Peters, Westphal-Castenau*); Paracale (*Peters*); Butuan, Mindanao (*Günther*); southern Mindanao (*J. G. Fischer*); Manila, Cuyo, Bantayan, Occidental Negros, Montalban (*Bureau of Science collection*). Widely distributed in southern India and the East Indian Islands.

$b^2$. No præocular; præfrontal entering the eye. Dark brown on the back and sides, crossed with broad bars of white.......... **Ophites subcinctus** (Boie).

Mindanao (*Boulenger*); Iwahig, Palawan (*Bureau of Science collection*). Found also in the Malay Peninsula, Borneo, Sumatra, and Java.

$a^2$. Anterior maxillary teeth increasing in size to the eighth or ninth, which is fang-like, followed by a short interspace, then 3 small teeth succeeded, without a second interspace, by 3 much enlarged, laterally compressed teeth .............................................. Genus **Haplonodon**.

The genus is represented by a single species. General color brown. The body and tail crossed by numerous (79) dark bands separated by narrow light bands .................. **Haplonodon philippinensis** Griffin.

Polillo (*Bureau of Science collection*).

$a^3$. Anterior maxillary teeth not enlarged, middle and posterior longest, no interspaces; pupil vertically elliptic.............................. Genus **Stegonotus**.

$b^1$. Not more than 100 subcaudals. Uniform brown above, whitish below.
**Stegonotus muelleri** Duméril et Bibron.

Samar (*Duméril and Bibron*); Cubo-cubo, Samar (*Peters*). Not recorded from any other place.

$b^2$. One hundred and twelve to 123 subcaudals. Grayish brown above with a median row of dark brown spots, and a row of smaller spots on each side; yellowish beneath .......... **Stegonotus dumerilii** Boulenger.

Surigao (*Günther*); Daraga, Iraga Volcano (*Peters*). Limited to the Philippines.

$a^4$. Anterior and middle maxillary teeth not enlarged; posterior increasing in size, or the last strongly enlarged.

$b^1$. Palatine and pterygoid bones toothed; pupil vertically elliptic. Maxillary teeth 8 to 10 .......... **Dryocalamus philippinus** Griffin.

Iwahig, Palawan (*Bureau of Science collection*). A single specimen only is known. Length, 241 millimeters. Black above, with 3 narrow, white longitudinal stripes; lower surface white.

$b^2$. Palatine and pterygoid bones toothed; pupil round.

$c^1$. Longitudinal series of scales in even numbers; maxillary teeth 20 to 23.
Genus **Zaocys.**

$d^1$. Scales in 14 rows .......... **Zaocys luzonensis** Günther.

Luzon (*Günther*). Only the type specimen appears to be recorded.

$d^2$. Scales in 16 or 18 rows; 2 median dorsal rows of scales keeled. Dark brown. This snake can be recognized instantly by the dorsal keels.
**Zaocys carinatus** Günther.

Iwahig, Palawan (*Bureau of Science collection*). Three specimens were recently captured in Palawan, where the snake is said to be common. This species has been found in Borneo, Sumatra, and the Malay Peninsula, but has not been recorded before from the Philippines. A large snake, reaching a length of 3 meters.

$c^2$. Longitudinal series of scales in odd numbers; ventrals rounded laterally. Maxillary teeth 8 to 12, posteriorly compressed.......... Genus **Holarchus.**

$d^1$. Two superposed anterior temporals. Dark brown, with an indistinct, lighter, vertebral stripe .......... **Holarchus octolineatus** (Schneider).

Tawi Tawi (*Boulenger*). Found in Java, Borneo, Sumatra, Malay Peninsula, and southern India.

$d^2$. A single anterior temporal. Above, light brown with transverse black-edged blotches. Rosy pink below, when alive.
**Holarchus phænochalinus** (Cope).

Luzon (*Boulenger*); Manila (*Cope*); southern Mindanao (*J. G. Fischer*); Daraga, Luzon (*Peters*); Manila, Benguet, Zambales (*Bureau of Science collection*). Known also from Java.

$c^3$. Longitudinal series of scales in odd numbers; ventrals with suture-like lateral keels, and a notch on each side corresponding to the keel. Scales of dorsal row large.......... Genus **Dendrophis.**

$d^1$. Scales in 15 rows. Olive, bronzy brown, or dark blue above. Usually striped along the sides. Lower parts greenish.
**Dendrophis pictus** (Gmelin).

Manila (*Duméril and Bibron*); Daraga, Albay; Mount Santik; Passino; Camarines (*Peters*); Loquilocun, Samar (*Peters*); Mindanao (*Duméril and Bibron*), southern Mindanao (*J. G. Fischer*);

Palawan, Manila, Mindoro, Tarlac, Polillo (*Bureau of Science collection*). Widely distributed over southern Asia, the Malay Peninsula and Archipelago.

$d^2$. Scales in 13 rows. Brown or olive above, lighter below.
**Dendrophis punctulata** (Gray).
Ticao (*Parenti and Picaglia*). Found elsewhere in northern and eastern Australia, New Guinea, and the Moluccas.

$b^3$. Palatine and pterygoid teeth absent or few; maxillary bone short, with 6 to 8 teeth in an uninterrupted series........................ Genus **Oligodon.**

$c^1$. Anal entire.

$d^1$. One postocular; no loreal. Dark brown above with a yellowish vertebral streak; yellowish below........ **Oligodon modestus** Günther.
Southern Negros (*Günther*). Found only in the Philippines.

$d^2$. One postocular; loreal present. "Dark purplish brown above, with yellow dots and a series of large transverse, rhomboidal, yellow, black-edged spots; head yellow, with two chevron-shaped black bands". (Boulenger.)........................ **Oligodon notospilus** Günther.
Mindoro (*Günther*). The type specimen only known.

$d^3$. Two postoculars; loreal present. Dark purplish brown above, with 11, dark red, rhomboidal spots along the back. Ventral surface rose-red ........................................ **Oligodon iwahigensis** Griffin.
Iwahig, Palawan (*Bureau of Science collection*).

$c^2$. Anal divided. Dark gray above, with very small, white, black-edged spots; 2 chevron-shaped transverse bands on the head; ventral surface orange ........................ **Oligodon schadenbergii** Boettger.
Busuanga (*Boettger*). Known only from this locality.

$a^5$. Maxillary teeth equal or nearly so, or the posterior ones decreasing in size.

$b^1$. Scales with apical pits.

$c^1$. Scales forming straight longitudinal series........................ Genus **Elaphe.**

$d^1$. Anal divided. Bright bluish green. A large snake reaching a length of 2.3 meters ........................................ **Elaphe oxycephala** (Boie).
Legaspi, Luzon (*Peters*); Iwahig, Palawan (*Bureau of Science collection*). Common to the eastern Himalayas, the Malay Peninsula and Archipelago.

$d^2$. Anal entire.

$e^1$. Without bars along sides. Nearly uniform reddish brown.
**Elaphe erythrura** (Duméril et Bibron).
Luzon, northern Leyte, Negros (*Günther, Boulenger*); Daraga, Luzon (*Peters*); Manila (*Jan*); Loquilocun, Samar (*Peters*); Mindanao (*J. G. Fischer*); Manila, Malabon, Tarlac; Occidental Negros, Polillo (*Bureau of Science collection*). Found also in Celebes.

$e^2$. With 3 to 14 black spots or bars on the anterior part of the body. Except for the spots the coloring is the same as of *E. erythrura*.
**Elaphe philippina** Griffin.
Iwahig, Palawan (*Bureau of Science collection*). Not known from any other locality.

$c^2$. Scales narrow and obliquely arranged; ventrals and subcaudals with suture-like lateral keels and a notch on each side corresponding to the keel; vertebral row of scales not enlarged...... Genus **Dendrelaphis.**

$d^1$. Four to 8 black stripes extending the length of the body. Bronzy or greenish yellow, the dark edges of the scales forming the black stripes which extend the length of the body.

**Dendrelaphis caudolineatus** (Gray).

Puerta Princesa, Palawan (*Boulenger*); Iwahig, Palawan (*Bureau of Science collection*). Found in southern India, Borneo, and Sumatra.

$d^2$. A single black stripe on each side extending the length of the body, 2 to 4 others on the posterior third of the body.

**Dendrelaphis terrificus** (Peters).

Albay (*Peters*); Ticao (*Parenti and Picaglia*); Loquilocun and Borongan, Samar (*Peters*); northern Mindanao (*Günther*); Camiguin (*Bureau of Science collection*). The few specimens secured indicate that this snake occurs over the entire Philippine Archipelago. It is also found in Celebes.

$d^3$. Olive above, scales finely edged with black; no black lines on the body.

**Dendrelaphis modestus** Boulenger.

Bongabon, Mindoro (*Bureau of Science collection*). Hitherto known only from Ternate, Malmaheira, and Batjan (Boulenger).

$d^4$. Upper surface dull, dark brown; skin under scales deep blue; ventrals bluish .................................. **Dendrelaphis cæruleatus** Griffin.

Siquijor, Banton, Negros Occidental, Polillo (*Bureau of Science collection*). Known from these localities only.

$d^5$. Seal brown above, slightly lighter below, under surface of head reddish brown .................................. **Dendrelaphis fuliginosus** Griffin.

Negros (*Bureau of Science collection*). Only the type specimen known.

$b^2$. Scales without pits.

$c^1$. Anterior temporal present .................................. Genus **Ablabes**.

$d^1$. Nostril in a single nasal which is completely divided from the internasal. Olive or greenish above, white below. A short black stripe on each side of the head and neck.

**Ablabes tricolor** (Schlegel).

Iwahig, Palawan (*Bureau of Science collection*). Also occurs in Java, Sumatra, and Borneo.

$d^2$. Nostril between nasal and internasal, which are completely fused in front of the nostril. Light yellowish-brown above, with 4 dark brown, longitudinal streaks, the middle ones broader than the lateral; whitish-yellow below ............ **Ablabes philippinus** Boettger.

Culion and Samar (*Boettger*); Iwahig, Palawan (*Bureau of Science collection*). Found only in the Philippines.

$c^2$. Anterior temporals absent, the parietals being in contact with the labials; nostril in a single minute nasal; no loreal. Very small snakes.

$d^1$. Internasals present .................................. Genus **Pseudorhabdium**.

$e^1$. Supraocular distinct; a præocular; frontal longer than broad. Iridescent brown, often with a yellowish collar.

**Pseudorhabdium longiceps** (Cantor).

Daraga, Luzon (*Peters*). Found also in the Malay Peninsula, Sumatra, Borneo, and Celebes.

$e^2$. Supraocular very small and united with the postocular; no præocular; frontal broader than long. Uniform iridescent dark brown ........................... **Pseudorhabdium oxycephalum** (Günther).

Negros (*Boulenger*). Found only in the Philippines.

$d^2$. No internasals ........................................................... Genus **Calamaria**.

$e^1$. Symphysial in contact with the anterior chin-shields.

$f^1$. Frontal less than twice as broad as the supraocular. Black above, barred with alternate bands of black and white below.

**Calamaria grayi** Günther.

Recorded by Günther as from the "Philippines," the definite locality being unknown. Not known elsewhere.

$f^2$. Frontal at least twice as broad as the supraocular. Rostral as deep as broad, frontal as long as the parietals. Brown above, uniform yellowish below .................... **Calamaria bitorques** Peters.

Luzon (*Boulenger*). Restricted to the Philippines.

$f^3$. Rostral as deep as broad; frontal shorter than the parietals. Brown above, with several fine light streaks on each side, yellow below (in spirit, white).

**Calamaria gervaisii** Duméril et Bibron.

Manila (*Jan*); Batu, Daraga, Paracale, Mount Iraga (*Peters*); Bataan (*F. Müller*); southern Negros (Günther); southern Mindanao (*J. G. Fischer*); Manila (*Bureau of Science collection*). A purely Philippine form.

$f^4$. Rostral broader than deep; frontal shorter than the parietals. Brown above with longitudinal series of black dots; a yellow spot on each side of the neck.

**Calamaria mindorensis** Boulenger.

Mindoro (*Boulenger*). Only the type specimen is recorded.

$e^2$. Symphysial not in contact with anterior chin-shields.

$f^1$. Diameter of eye much more than its distance from the mouth. Brown above, with two longitudinal rows of dark spots on each side ....................................... **Calamaria everetti** Boulenger.

Palawan, (*Boulenger*); Iwahig, Palawan (*Bureau of Science collection*). Also found in Borneo.

$f^2$. Diameter of eye less than half its distance from the mouth; 250 ventrals. Dark brown above, with the two outer scale rows tipped with yellowish; a yellow collar on the neck; a pair of large pale lateral spots at the base of the tail.

**Calamaria mearnsi** Stejneger.

Mindanao (*Stejneger*). Only the type specimen recorded.

$d^3$. Internasals present; eye concealed under the ocular shield. Uniform blackish, scales edged with white. A Philippine genus with a single species ......................................... **Typhlogeophis brevis** Günther.

Northern Mindanao or Dinagat (*Günther*). Only the type specimen known.

## Series B. *Opisthoglypha.*

One or more of the posterior maxillary teeth grooved and usually enlarged, forming small fangs. The snakes of this series are poisonous, but on account of the position of the fangs in the back of the jaw and their small size, they are not often dangerous to man. Their prey consists principally of lizards and small mammals which they paralize before swallowing.

$a^1$. Nostrils valvular, on the upper surface of the snout; aquatic snakes.

Subfamily **Homalopsinæ.**

$b^1$. Nasals in contact. Scales keeled; numerous small scales in place of the parietals ........ Genus **Hurria.**

$c^1$. Four lower labials in contact with the anterior chin-shields; scales strongly keeled, in 23 to 27 rows, ventrals 132 to 160. Light brown above and below, spotted and barred with dark brown.

**Hurria rhynchops** (Schneider).

Manila (*Jan*); Batu, Daraga, and Buhi, Luzon (*Peters*); Negros (*Günther*); Placer, Mindanao (*Günther*); Palawan (*Boulenger*); Bantayan, Polillo, Palawan, Cuyo (*Bureau of Science collection*). Found along the coasts of India, Ceylon, the Malay Peninsula and Archipelago, the Pelew Islands, Timor, and the Moluccas.

$c^2$. Three lower labials in contact with the anterior chin-shields; scales fully keeled, in 29 rows; ventrals 163 to 165. Color about the same as in *Hurria rhynchops* (Schneider) ........ **Hurria microlepis** (Boulenger).

Philippines (*Boulenger*); Camiguin (*Bureau of Science collection*). Not recorded from any other locality.

$b^2$. Nasals separated by a single internasal. Dark olive or gray above, with a broad white band on each side.

**Gerardia prevostiana** (Eydoux et Gervaise.)

Manila (*Duméril and Bibron*). Found along the coasts of India, Ceylon, and Burma.

$a^2$. Nostrils not valvular, lateral; mostly tree or bush snakes.

Subfamily **Boiginæ.**

$b^1$. Anterior mandibular teeth strongly enlarged; scales without pits; subcaudals single; pupil round; scales smooth; solid maxillary teeth equal, 20. Hypapophyses developed to some extent throughout the vertebral column. Brown above, with black spots on the head and neck, and a black line on each side of the posterior part of the body and the tail; lower parts yellowish ........ **Hologerrum philippinum** Günther.

Philippines (*Boulenger*). A genus containing only a single species, and limited to the Philippines.

$b^2$. Solid maxillary teeth subequal; head very distinct from neck, pupil vertical.

Genus **Boiga.**

$c^1$. Anterior palatine teeth but slightly enlarged.

$d^1$. Snout longer than the diameter of the eye; scales in 21 rows. Ringed by alternating, broad black and narrow yellow, bars.

**Boiga dendrophila** (Boie).

Samar (*Peters*); Mindanao (*Günther*); southern Mindanao (*J. G. Fischer*); Palawan and Mindanao (*Boulenger*); Palawan, Rizal Province, Polillo (*Bureau of Science collection*). Found throughout the Malay Peninsula and Archipelago.

$d^2$. Snout as long as the eye; scales in 19 rows. Grayish or yellowish brown, with dark brown spots and cross bars, the latter extending across the belly ........ **Boiga angulata** (Peters).

Leyte (*Peters*); Polillo (*Bureau of Science collection*). A strictly Philippine species.

$c^2$. Anterior palatine teeth strongly enlarged.

$d^1$. Scales in 19 rows. Brownish yellow above with black cross-bars.

**Boiga philippina** (Peters).

Luzon (*Peters*). Not found elsewhere.

$d^2$. Scales in 23 to 25 rows. Fawn-colored, reaching a length of 2 meters. **Boiga cyonodon** (Boie).

Mindanao (*Günther*); Palawan and Polillo (*Bureau of Science collection*). Found also in Assam, Burma, the Malay Peninsula and Archipelago.

$b^3$. Solid maxillary teeth subequal; scales with apical pits. Pupil round or horizontal.

$c^1$. Pupil horizontal. Pale brown, mottled with darker color. **Dryophiops philippina** Boulenger.

Cape Engaño, Luzon (*Boulenger*); Manila (*Bureau of Science collection*). Known only from Luzon.

$c^2$. Pupil round. Usually black above, with white markings on the head, and a series of red flower-shaped spots on the back. Sometimes the snake is uniform light brown or brownish-gray, without markings. **Chrysopelea ornata** (Shaw).

Manila (*Steindachner*); Lauang, Samar (*Peters*); southern Mindanao (*J. G. Fischer*); Manila, Banton, Bantayan, Palawan, Mindoro, Polillo (*Bureau of Science collection*). Widely distributed throughout the Malay Peninsula and Archipelago.

$b^4$. Solid maxillary teeth unequal, the middle ones longest.

$c^1$. Pupil vertically subelliptic. Iridescent dark brown; lower parts powdered with brown dots .......................... **Psammodynastes pulverulentus** (Boie).

Balabac, Palawan, Mindanao, Dinagat, Albay (*Boulenger*); Palawan, Mindanao, Negros, Polillo, Sorsogon (*Bureau of Science collection*). Widely distributed in southern Asia, Formosa, the Malay Peninsula and Archipelago.

$c^2$. Pupil horizontal. Typically, leaf-green above, with a narrow yellow lateral line; yellowish green below. The color varies greatly, gray, pink, dark red, dark blue, and yellow specimens being found. Commonly known as the rice snake or *dahon-palay*.......................... **Dryophis prasinus** Boie.

Sibutu, Mindanao, Luzon (*Boulenger*); Daraga and Albay (*Peters*); Samar (*Peters*); southern Mindanao (*J. G. Fischer*); Polillo, Negros, Bataan Province, Camiguin, Palawan (*Bureau of Science collection*). Distributed throughout southern Asia, the Malay Peninsula and Archipelago.

## Series C. *Proteroglypha.*

The anterior maxillary teeth grooved or folded into a tube, and usually considerably enlarged. Venomous snakes.

$a^1$. Tail strongly compressed into a vertical fin.......................... Subfamily **Hydrinæ**.

$b^1$. Ventral shields small or absent.

$c^1$. All maxillary teeth grooved (some are often very faintly grooved); 4 to 10 small teeth follow the fangs.......................... Genus **Disteira**.

$d^1$. Head very small; diameter of neck not half the greatest depth of the body .......................... **Disteira fasciata** (Schneider).

Manila (*Peters*). Found from India to New Guinea.

$d^1$. Distinguished from *D. fasciata* (Schneider) by characters which can not be readily included in this key, is **Disteira cincinnatii** Van Denburgh and Thompson.

Manila Bay (*Boettger. Van Denburgh and Thompson*). Not recorded from any other locality.

$d^2$. Head not remarkably small; diameter of neck more than half the greatest depth of the body.

$e^1$. Second pair of chin-shields separated by several scales.

$f^1$. Two or 3 superposed anterior temporals...... **Disteira ornata** (Gray).

Iwahig, Palawan (*Bureau of Science collection*). Coasts of southern Asia to northern Australia.

$f^2$. A single anterior temporal...................... **Disteira semperi** (Garman).

Lake Taal, Luzon (*Garman*). Not known elsewhere.

$e^2$. Second pair of chin-shields in contact or separated by 1 scale.

$f^1$. One postocular, one anterior temporal; head black above, with a crescentic yellow mark ............................ **Disteira spiralis** (Shaw).

Manila (*Jan*). Found on the coasts of India and the Malay Archipelago.

$f^2$. Two postoculars, two superposed anterior temporals.

$g^1$. Thirty-nine to 45 scales around the middle of the body.

**Disteira cyanocincta** (Daudin).

Manila (*Jan*); Cebu (*Boulenger*). Found on the coasts of the Persian Gulf, India, China, Japan, Formosa, and the Malay Archipelago.

$g^2$. Second upper labial in contact with the præfrontal; 34 scales around the body; grayish with darker cross-bars.

**Disteira longiceps** (Günther).

Manila Bay (*Bureau of Science collection*). Recorded from the Indian Ocean.

$c^2$. Maxilla short; 2 to 5 small, faintly grooved teeth follow the large fangs. Body short and stout; scales polygonal, juxtaposed. Alternating transverse bands of black and yellow........................ **Lapemis hardwickii** Gray.

Manila (*Jan, Steindachner*); Manila and Negros (*Boulenger*); southern Mindanao (*J. G. Fischer*); Manila (*Bureau of Science collection*). Found from the coasts of India to New Guinea.

$b^2$. Ventrai shields large.

$c^1$. Nostrils on upper surface of snout; nasals in contact with each other; 8 to 10 grooved teeth in addition of the fangs.

**Aipysurus eydouxii** (Gray).

Philippines (*Boulenger*). Recorded also from Singapore and Java.

$c^2$. Nostrils lateral; nasals separated by internasals; one or two small solid teeth in addition to the fangs.......................................... Genus **Laticauda**.

$d^1$. No unpaired shield between the præfrontals.

**Laticauda laticaudata** (Linnæus).

Samar (*Peters*). Widely distributed along the northern and eastern coasts of the Indian Ocean.

$d^2$. An unpaired shield between the præfrontals. The largest of our marine snakes, reaching a length of more than 2 meters. Olive or yellowish with broad, brilliant, black rings.... **Laticauda colubrina** (Schneider).

Luzon (*Peters*); Jolo (*Günther*); Palawan, Bantayan (*Bureau of Science collection*).

$a^2$. Tail cylindrical. Poison fangs well developed..................... Subfamily **Elapinæ**.

$b^1$. Internasal bordering the nostril; scales oblique............................ Genus **Naja**.

$c^1$. Seventeen to 25 scales around the middle of the body, 21 to 35 scales around the neck; rostral 1.25 to 1.5 times as broad as deep.

**Naja naja** (Linnæus).

$d^1$. Pale brown or yellowish without markings on body or head; 25 to 31 scales across the neck, 21 to 25 across the body.

**Naja naja** var. **cæca** Gmelin.

Northern Luzon (*Boulenger*); Manila, Palawan (*Bureau of Science collection*). Distributed from Transcaspia to Java.

$d^2$. Dark brown or black; 21 to 23 scales across the neck, 17 to 19 across the body ........................................ **Naja naja** var. **miolepis** Boulenger.

Palawan (*Boulenger*); Palawan (*Bureau of Science collection*). Recorded only from Borneo and Palawan.

$c^2$. Seventeen to 19 scales around the body; 21 or 23 around the neck; rostral one and two-thirds times as broad as deep. Darker brown than *Naja naja* var. *cœca* ................................................ **Naja samarensis** (Peters).

Samar (*Peters*); Mindanao and Leyte (*Boulenger*); Samar (*Bureau of Science collection*). Known only from Samar, Leyte, and Mindanao.

$c^3$. Fifteen scales across the middle of the body, 19 or 21 across the neck; a pair of large occipital shields back of the parietals. The largest of venomous snakes, it is said to prey exclusively upon other snakes. This species is often called the king cobra or hamadryad. Nearly uniform light brown ........................................ **Naja bungarus** Schlegel.

Samar (*Peters*); southern Mindanao (*J. G. Fischer*); Isabela (*Boulenger*); Benguet, Palawan, Laguna (*Bureau of Science collection*). Widely distributed throughout India, southern China, the Malay Peninsula and Archipelago.

$b^2$. Internasal not bordering the nostril.

$c^1$. Scales in 15 rows........................................ Genus **Hemibungarus.**

$d^1$. Two anterior temporals, 6 upper labials. Nearly black above, with narrow, white cross-bars; red beneath, with black bars.

**Hemibungarus calligaster** (Wiegmann).

Manila (*Jan, Wiegmann*); Daraga, Mount Isarog (*Peters*); Albay (*Peters, Boulenger*); Bataan Province (*F. Müller*); southern Mindanao (*J. G. Fischer*); Rizal, Polillo, Laguna (*Bureau of Science collection*). Occurs only in the Philippines.

$d^2$. No anterior temporals; the parietal touching the sixth labial; 7 upper labials. Black above, with a yellowish collar on the neck; barred with red and black below................ **Hemibungarus collaris** (Schlegel).

Manila (*Jan*); Philippines (*Boulenger*). Found only in the Philippines.

$c^2$. Scales in 13 rows........................................ Genus **Doliophis.**

$d^1$. Diameter of eye much more than one-half the distance of the eye from the mouth. Dark brown above with 2 white longitudinal stripes.

**Doliophis bilineatus** (Peters).

Palawan (*Peters*); Palawan, Balabac, Mindanao (*Boulenger*); Palawan (*Bureau of Science collection*). Found only in the Philippines.

$d^2$. Eye half as long as its distance from the mouth. Dark brown on the back and sides, crossed by narrow white bars, which widen on the ventral surface; the remainder of the ventral surface black.

**Doliophis philippinus** (Günther).

Southern Mindanao (*A. B. Meyer*); Manila (*Bureau of Science collection*). Restricted to the Philippines.

## Family AMBLYCEPHALIDÆ.

No median (mental) groove beneath the chin; body compressed; maxillary bone very short, with 5 subequal teeth; head very distinct from neck; eye large, with vertical pupil; scales smooth, oblique, without pits, in 13 rows; subcaudals single (unpaired).

Light brown. Easily distinguished by the small, deep, almost cubical head, which is very distinct from the neck........................ **Haplopeltura boa** (Boie).
Southern Mindanao (*J. G. Fischer*); Palawan and Balabac (*Boulenger*); Iwahig, Palawan (*Bureau of Science collection*). Found also in Pinang, Borneo, Java, and the Moluccas.

## Family VIPERIDÆ.

Maxilla very short, capable of being erected, and bearing only a pair of large, hollow, poison fangs.

### Subfamily CROTALINÆ.

A deep pit between the eye and the nostril. Head large, distinct from neck, triangular.

Only one genus is found in the Philippines. Most of these snakes are arboreal and are protectively colored. Their bite is dangerous.... Genus **Trimeresurus.**

$a^1$. Tail prehensile.

$b^1$. Scales between the eyes smooth.

$c^1$. Ventrals 145 to 175; supraocular narrow; nasals in contact, or separated by 1 or 2 scales. Dark green above, with a yellow streak along the outer row of scales on each side of the body.
**Trimeresurus gramineus** (Shaw).
Paracale (*Peters*); southern Mindanao (*J. G. Fischer*); Iwahig, Palawan (*Bureau of Science collection*). Found in all parts of southeastern Asia and the Malay Archipelago.

$c^2$. Ventrals 170 to 187; snout prominent; supraocular narrow, 2 or 3 scales between nasals; 8 to 10 between supraoculars. Bright green above, with a yellow spot on each scale of the lateral rows.
**Trimeresurus flavomaculatus** (Gray).
Mindanao (*F. Müller, J. G. Fischer, Günther*); Luzon (*Boulenger*); Laguna Province and Batan Island (Batanes) (*Bureau of Science collection*). Occurs only in the Philippines.

$c^3$. Ventrals 180 to 191; supraocular large, 4 to 9 scales between supraoculars. Bright green, with 2 series of white spots along the back.
**Trimeresurus sumatranus** (Raffles).
Palawan (*Boulenger*). Found also in Borneo, Sumatra, and Singapore.

$c^4$. Ventrals 203; supraoculars narrow; internasals small, separated by 2 scales of similar size. Bright green, with fine black lines above; outer row of scales, canary-yellow ...................... **Trimeresurus schultzei** Griffin.
Iwahig, Palawan (*Bureau of Science collection*).

$b^2$. Upper head scales all strongly keeled. Bright green, with white and purple, or white and red, vertical bars on the sides.. **Trimeresurus wagleri** (Boie).
Mindanao (*Gmelin, Peters, F. Müller, Günther, J. G. Fischer*); Samar (*Peters*); Palawan, Albay (*Boulenger*); Palawan (*Bureau of Science collection*).

$a^2$. Tail not, or but slightly, prehensile. Red-brown to blue above, bluish beneath. No yellow lateral stripe. Tail colored like the body.

**Trineresurus halieus** Griffin.

Polillo (*Bureau of Science collection*). Known only from this locality.

DOUBTFUL SPECIES.

*Tropidonotus dorsalis* Günther is classified by Boulenger [9] as *Pseudoxenodon dorsalis* (Günther). The genus is limited to China and southern India. The reference of a specimen of this species to Manila seems doubtful.[10]

*Topidonotus* aff. *hypomelas* Günther [11] is probably *Natrix dendrophiops* (Günther).

*Leptophis vertebralis* Duméril et Bibron, from Luzon,[12] is probably a *Natrix,* which it is not possible to place more definitely at the present time.

*Naja naja* (Linnæus) var. *sputatrix* Boie, listed as from Mindanao by F. Müller [13] should probably be *Naja naja* var. *miolepis* Boulenger.

There is some mistake in referring [14] *Piesogaster boettgeri* Seoane to Panay and Polloc.[15] Boulenger [16] includes this species under *Epicrates inornatus* (Reinhardt) and gives Jamaica, Santo Domingo, and Porto Rico as the localities in which it occurs, making no mention of Panay and Mindanao.

[9] Cat. Snakes, Brit. Mus. (1893), **1**, 271.

[10] F. Müller, I. Nachtr. Cat. Herp., Samml. Basel Mus. (1880), 31.

[11] F. Müller, III. Nachtr. Cat. Herp., Samml. Basel Mus. (1883), 15.

[12] Duméril et Bibron, Erpétologie gén. (1854), **7**, 543.

[13] F. Müller, III. Nachtr. Cat. Herp., Samml. Basel Mus. (1883), 18.

[14] Seoane, *Abhandl. Senck. Ges.* (1880), **12**, 217. Pl. 1.

[15] Boettger, O., *Ber. Senck. Ges.* (1886), 115.

[16] Cat. Snakes, Brit. Mus. (1893), **1**, 97.

# ILLUSTRATIONS.

TEXT FIGURES.

FIG. 1. Head of *Dendrelaphis cœruleatus* Griffin. (Drawing by Espinosa.)
2. Upper figure; vertebra with a hypapophysis projecting from the lower side of the centrum. Lower figure; vertebra without hypapophysis. (From Boulenger.) 269

# REVIEWS.

**The First Grammar of the Language Spoken by the Bontoc Igorot with a Vocabulary and Texts, etc.** By Dr. Carl Wilhelm Seidenadel. Price $5. Chicago. The Open Court Publishing Company, 1909. (Date of publication: April 1910.)

This grammar of a hitherto unexplored dialect spoken far up in the mountain fastnesses of northern Luzon can not but have come as a surprise to persons resident in the Philippine Islands and interested in the study of the vernaculars of their peoples since it originated on the opposite side of the globe, at Chicago, in the heart of the United States of America. The explanation is, perhaps, in more than one sense, characteristic of the new order of things.

The bulk of hitherto existing grammars and vocabularies on Philippine languages is made up of more or less time-honored works written by Spanish friars to whom the study of these languages was of immediate practical interest. It is characteristic of these works, especially of the older "Artes y Bocabularios," products of years of linguistic study and practice among the natives, that they existed often for a considerable time only in manuscript form, and thus were copied and passed on from colleague to colleague and from one generation of missionaries to another, until, after many corrections and additions, they ultimately appeared in print in Manila.

Here, now, we have the work of an American philologist, Dr. Wilhelm Seidenadel, who, without leaving Chicago, his place of residence, has been in contact for not more than about six months (two and one-half months in 1906, and three and one-half months in 1907) with two successive groups of Bontok people, who, from their mountain home in far Luzon, were sent to America for exhibition. Their presence excited in him a great interest in the strange tongue and he set himself to study it.

"The difficulties seemed at first unsurmountable, for none of those whom the author met at first understood English sufficiently well to comprehend questions or to give explanations. Thus it became necessary to force the way into their idiom by their idiom, but what had appeared, in the beginning, to be almost a misfortune, proved afterwards to be a blessing: the necessity of using in the research almost exclusively their vernacular, through which the investigator succeeded in gaining genuine and correct material, such as in many other Malayo-Polynesian idioms is collected from unreliable translations of the Bible, from prayerbooks, manuals for priests, reports of unphilological officials, traders, missionaries and similar sources. While the material was taken down during the

first few weeks without any definite plan, the fascinating success soon induced the author to proceed systematically. Henceforth it was his aim to elicit from the Igórot as many examples as possible, illustrative of grammatical rules already sketched, and to collect an extensive vocabulary of genuine Bontoc Igórot words. But, as a matter of no less importance, he never neglected to take down also from the Igórot's mutual conversation as many phrases as he could obtain, although the significance of most of them was quite obscure, at that first period of his research."

I take these quotations from the author's narration of the genesis of his work as given by him in the preface. To judge by the date of the latter, the writing of the grammar was finished by October 18, 1907, that is, two months after the departure of the last group of Bontok people from Chicago. This is indeed a remarkable achievement of rare linguistic talent combining enthusiasm and perseverance in a self-imposed scientific task. The magnificent volume in which the labors of the author have found their embodiment may truly be regarded as a monument erected to these qualities by that group of American citizens who through their munificence made possible the publication of this work.

The main parts of the book are:

A collection of photographs showing, in various attitudes, individuals and groups of those representatives of the Bontok people who went to Chicago on exhibition.

An inscription to the patrons alluded to above.

Preface (pp. VII–XV).

List of contents (pp. XVII–XXIV).

Part I: Grammar, with appendix on Bontok proper names (pp. 1–270).

Part II: Vocabulary, with preface (pp. 273–475).

Part III: Texts, with preface including a section "To the memory of Matyu from Bontoc" (†Detroit, Michigan, September 3, 1908) (pp. 479–583).

Addenda et Corrigenda (pp. 587–588).

In connection with the epitaph just mentioned, I may dwell here on a feature of Doctor Seidenadel's work which impresses us in different parts of the book. It is his profound humane sympathy with his Bontoc friends, a sympathy which, transcending the mere professional interest taken by a scientist in the object of his study, would seem to be—according to the dictum: "Alles Verständnis kommt uns nur durch die Liebe"—a guarantee of the faithfulness with which he has interpreted in his grammar genuine Bontok thought and speech.

### THE PREFACE.

The preface, as has already been indicated, makes us acquainted with the peculiar circumstances under which the book was conceived and born. After a review of the literature already existing on Bontok the author proceeds to give us an insight into the purpose and plan that guided him in writing his grammar. To explain the absence in it of all comparative studies, he states that he considered it his task

"to furnish material for such studies, to contribute at least a certain amount of reliable material for comparative research, which ought to be based upon the results of new, uninfluenced investigations—fieldwork—into the various idioms as spoken by the natives, and not upon religious books made by missionaries and their apprentices. It were best to consider the entire field of Philippine languages as yet untouched and to begin anew to study (but not without personal sympathy with the natives!) 'jene Prachtwerke des malaiischen Baustils, die philippinischen Sprachen,' . . . . ." Concerning the plan underlying the grammar we are told: "While composing the grammar, several methods of arranging the material suggested themselves. The Author concluded—indeed not without hesitation—that it would be more convenient for students trained in the grammars of Indogermanic Languages, if he would retain, with slight modifications, the customary order of the chapters in such grammars, if he would first treat the articles, then the noun, pronoun, adjective, etc., just as if the Bontoc Language would distinguish the same grammatical categories as the Indogermanic Languages. This method seemed helpful for acquiring knowledge of the idiom, but for practise the student must absolutely abandon those former conceptions of etymology and syntax which he may have gained from his previous studies of the classical or modern Germanic or Romance Languages; the sooner he can free himself completely from clinging to his former notions of the structure of a language and adapt himself to new categories of linguistic elements, the earlier he will succeed in entering into the spirit of this admirable idiom."

It appears herefrom that, while the book is primarily intended to furnish material for studies in comparative Indonesian philology, that material is presented in such a form that it is available also for those familiar only with grammars of Indogermanic languages. The grammar is thus both critical and didactic; it investigates and discusses, and it teaches and is intended to be practiced. The combination of these two tasks offers, of course, certain difficulties, and where no systematic division is instituted, the claimants of either of the two spheres of interest involved must have the good grace to make certain concessions to those of the other.

To consider first the interests of "the tradesman, the engineer, the teacher, the missionary, the official," who are given directions on page 279 how to derive practical advantage from the book, the reviewer is of the opinion that they could hardly do better than imitate the splendid example set by the author himself and use the vernacular from the very outset in talking with the natives. If, having thus acquired a smattering of the language, they begin reading the grammar, taking a suitable section day by day, and consult the book on every point of interest arising, they will certainly come to feel grateful to the author for his research work, and will be in a position fully to appreciate its merit.

### LIST OF CONTENTS.

Both the practical student and the philologist probably will regret that the treasure of information stored in this volume has not been made somewhat easier of access. The List of Contents, as far as it refers to the grammatical part, might advantageously have been made more synoptical by preserving in it the same division into chapters and sections into

which the text is actually divided. Without the headings used in the text and reduced to a running enumeration of the 462 paragraphs that make up the grammar, the List of Contents makes the latter wrongly appear a mere aggregate of grammatical details, among the great mass of which any particular matter is not easily detected.

### THE GRAMMAR.

The Grammar begins by stating by whom the Bontok language is spoken, and its territorial extension.

The author then gives a list of the symbols used by him to represent the sounds of that speech. As we become acquainted with the many indistinct, fluctuating, and interchanging sounds with which it abounds, we realize the difficulties the author had to conquer in making his way through this first barrier and must admire the conscientious and painstaking manner in which he has undertaken to present to us throughout the book the peculiar Igorot sounds according to his system. It is but a proof of this conscientiousness that he, himself, in the preface calls attention to some inconsistencies in orthography, accents, and quantity. We are told that these are but a consequence of the changing elocution of the natives for whom he did not consider himself entitled to create a normal language. This is a very sensible remark, and one that touches at the root of the controversies which arise from time to time over the proper graphic representation of several sounds occurring in all these Indonesian languages, written or unwritten. Where the speakers themselves, contemporaries in the same town or settlement, are not yet agreed, one with the other, nor each with himself, as to a definite pronunciation of their tongue, the exploring linguist would indeed commit a mistake in covering up the existing unstableness by fixing a normal spelling for himself. There is one statement in the author's description of Bontok Igorot sounds upon which some comment may be useful as it relates to an apparent divergence of views found among some authors on Indonesian languages. Under the heading diphthongs, the author states: "All diphthongs are vocalic with a final consonantal sound *y* or *w*." Regarding the class of diphthongs here implied, a similar remark is often met with, namely, that the second part of the combination contains something consonantal, or is a consonant. To explain this sound the two symbols, *y* (in Dutch *j*) and *w*, are referred to. It would certainly promote a clearer understanding if, instead of two ambiguous letters the pronunciation of which varies with different nationalities, a physiological description of this consonantal something were given. What is to be understood here by "consonant"? Is it, in the etymological sense, a sound which, more or less indistinct to the ear if alone, only *sounds together* with a vowel? This would be nothing more than the ordinary character of the second

part of the diphthongal combination here discussed, so that, once *called diphthongs*, it would be understood that the first part of the combination *carries* the syllable while the second part is reduced so as to give just a margin of different vocalic color to the first, *remaining, however, vocalic to the end.* The reviewer, for his part, has not been able to detect more than this in the mouth of Filipinos of different tribes whom he has asked to pronounce those diphthongs, nor can he find it in the examples by which the author illustrates some of the Bontok Igorot diphthongs:

"*ay* nearly like ai in aisle
"*ey* nearly like ey in eye, or ei in height
"*oy* as in boy."

But by the term "consonant," used in the case alluded to, more may be meant. That term is also defined as denoting, in the precise case here under discussion, a sound in the production of which that narrowing between lip and lip, and between tongue and palate, which is necessary for the articulation of *u* and *i* respectively is carried to the degree of becoming an obstruction to the passage of the breath, thus producing that rubbing sound which is characteristic of the class of consonants involved (spirants or fricatives) and in which the vocalic element becomes extinguished. To this class belongs the sound contained in certain French words cited by the author to illustrate the following diphthongs:

"*öy* as in French feuille,
"*uy* as in French fouille,
"*üy* as in French tuyau."

As regards the group "*ao, au,* as in how" it would seem that as long as the lips in pronouncing the second part of the combination remain sufficiently open to make a fluctuation between *o* and *u* at all noticeable it is not probable that the narrowing required for the labial spirant is reached; neither is it reached in the English word "how" used as example.

After a detailed exposition of Bontok Igorot phonology the author proceeds to treat consecutively: the Article, Noun, Pronoun, Adjective, Verb, Numerals, Prepositions, Adverbial Expressions, Particles, Conjunctions, etc. In so doing he amply fulfills his promise in the preface, to assist the student in all possible ways on each page of the grammar by establishing rules, by an abundance of examples and by frequent literal translations not only into English, but, wherever considered more helpful, into German, French, Spanish, and Latin. As, at the same time, he dwells upon and explains in their finer shades the turns of Igorot phraseology, the student, in advancing, also becomes initiated into the spirit and rules of syntax, so that, when the last part of speech is reached, there remain to be considered only a few special syntactical constructions. Chapters like Modifiers of Verbs (p. 117–130), Auxiliaries Constructed

with Ligature *ay* (p. 130–134), Modifying Verbs (p. 134–138), Negatives (p. 138–148), which are among the most interesting of the book, show clearly how profoundly the author has penetrated the intimacy of Igorot speech notwithstanding the short time allowed him for its practical study. The grammar in general convinces us that the material, in the first place, has been collected with great care and diligence, and afterward very studiously arranged so as to present it to the student as one systematic whole.

It is in connection with this latter point, namely, the systematization given by the author to his matter, that I wish here to take up and extend a little the remarks made at the beginning on the formation of Philippine grammars in the past.

Since it has been recognized that every language carries its order in itself, it is a just demand that this natural methodical disposition of its several parts be made the basis upon which the structure of any language, or group of closely related languages, be presented in a grammar. In the older Philippine grammars, those written by Spanish friars, we find this principle generally not carried out, either because it had not yet been established clearly and universally at that time, or because any attempt to evolve a natural system or order was subordinated to the practical purpose of instructing the younger members of those religious corporations in a manner then considered most adapted to their previous schooling in Latin. The fact is that Latin furnished the model for these Indonesian languages. Latin grammatical categories, by more or less specious interpretation of the native forms, were also found in Tagalog, Pampanga, Pangasinan, etc. As far as concerns the interest of the vernaculars, and not that of the students, the procedure was clearly recognized as improper, at least by some authors. Thus P. Francisco Lopez, the excellent Ilocanist, says: "Aunque el idioma de estas lenguas es muy diferente de el de la lengua latina; con todo eso, en cuanto fuere posible, nos conformarémos con el método de el Arte de Antonio de Nebrija, por ser él por donde los mas de los Religiosos que vienen á estas Islas han estudiado el latin. Y así hallarân mas claridad y facilidad en aprender esta lengua."[1] But the evil produced, the obscuration of the genuine character of these languages, makes itself felt till to-day, both in the Philippines and outside, and the condemnation in Doctor Seidenadel's Bontok Grammar of a particular "fallacy"—of which more presently—merits the more attention as he is a classicist himself. How ill adapted Latin as a grammatical taskmaster for an Indonesian language really is, may be gathered from an extract of what may be called a summary of the shortcomings of Austronesian languages if tested upon the presence in them of grammatical forms characteristic of inflectional languages, as given by Doctor Codrington in his classical work on the Melanesian languages: "These languages, all of them, are destitute of inflexions, and this gives them a common character. There are, therefore. no Declensions or Conjugations: there are no Cases, no Genders, and, excepting Pronouns, there is no Number or Person. Since, then, these grammatical forms do not exist, it is unreasonable and undesirable to speak of them as if existing . . . . Corresponding with the absence of Inflexion there is an absence of those variations in the form of words which may distinguish the Parts of Speech. It is not that there is a complete absence of such special

[1] Gramática ilocana, compuesta por el P. Predicador Fr. Francisco Lopez . . . . Third edition, Malabon (1895) p. XIII. (First edition 1627.)

forms as Verb or Noun, but that the same word, without any change of form, may be in use as almost any of the parts of Speech. The use of the word, not its form, commonly declares its character . . . . ."[2]

The first among Spanish grammarians to depart from the traditional Latin observance was probably P. Toribio Minguella. For the use of other than Latin-bred students he published in 1878 a Tagalog grammar which, perhaps on account of its being an attempt in a new direction, he modestly called "Ensayo de gramatica hispano-tagala." In this work he endeavors to do more justice to the language itself. Besides fitting the grammar for practical use by giving exercises and matter for reading and translating, he guides himself, in presenting the structure of the language, more by its own forms, and introduces certain terms denoting grammatical categories under discussion of their definition and their applicability to Tagalog.

As was seen in a previous quotation from Doctor Seidenadel's preface, the proper arrangement of his material has been with him likewise a matter of consideration. Consulting in this respect the convenience of students trained in Indogermanic languages, he decided to adhere, with slight modifications, to the customary order observed in those grammars, designating that order, however, as one applied to his grammar only "as if the Bontoc language would distinguish the same grammatical categories as the Indogermanic languages." We are, then, not at liberty to look upon the order followed by the author as representing his views on the proper systematic presentation of an Indonesian language such as Bontoc Igorot; but we are also absolved for the same reason, from giving consideration to that hypothetical plan from this point of view.

Still, as already indicated above, at one point of his chosen plan the author makes a strong criticism of the views held by a number of Indonesian philologists concerning certain classes of derivatives particularly characteristic of Philippine languages, and since the reviewer is completely in accord with the negative part of the author's contention, and believes that the time has come for a revision of prevailing views involved, he extracts here some of the paragraphs in Doctor Seidenadel's grammar which bear directly on the matter.

212. If roots shall be formed into Nomina actionis, they receive (after certain phonetic changes [220]) one of these verbalizing particles:
   I. the suffix *-en* (but no prefix)
   II. The suffix *-an* (but no prefix)
   III. the prefix *i-* (but no suffix)

213. By combination with one of these particles the root is transformed into an Active Verbal Noun. The particles indicate that the action named by the root passes from the agent to an object. They give the Active Verbal Noun transitive force.

216. Since the Nomen Actionis possesses active force—as has become evident through many various experiments with the spoken language—the relations of the direct object or accusative, in our conception, to the Nomen Actionis with *-en* is: (*a*) Either the object of the Nom. act. is in the accusative; it is governed by the Nom. Act. which has its transitive force in the suffix *-en*. If we represent this transitive force of

[2] The Melanesian Languages by R. H. Codrington, D. D. Oxford 1855, pp. 101–102. The judgment quoted may appear somewhat severe; as a remedy against the belief in the universality of Latin categories, it is certainly wholesome.

*-en* by our verbs "to affect," or "to concern" or "to influence," we obtain this translation:

*leytjenmi tjaitja:* our liking concerns them.[3] (*b*) Or the object is in the predicative nominative; the transitive force of *-en* may be indicated by words like "aim," "object":

*alaentako nan tolfeg:* our taking-object (is): the key

217. The relation of the object to the Nomen actionis with suffix *-an* is analogous to the construction mentioned in [216], if we assume the possibility that *-an* is probably identical with *-aen*, or merely a variation of *-en*, in this combination with Nom. actionis. The following theory seems to be more plausible: *-an* is the locative particle, as affixed to substantives in [56–58]. The object is the place where the action named by the Active Nom. act. "takes place", to which it tends; it is the end of the action. We can translate:

ayakantako nan aliwidtako our calling-end (is): the man[4]

218. The relation of the object to Nomina actionis with the prefix *i-* appears to be the same as that to Nom. Act. with *-en; i-* performs here a similar function as *-en* does there; *i-* directs the action towards the aim, the object.

(*I-* may be compared with our prefix be- in bespeak, befall: or it may represent the preposition *is*, and may then be compared with invade, offend, persuade, provide, and other prepositional compounds.)

In certain cases *i-* points to a person in whose behalf another acts, and to the tool which a person uses in performing or executing that which the Nom. act. names;

*itafongko nan soklongna* my hiding affects his hat. The discussion of the constructions in the examples of *-en, -an, i-* Verbs given [216–218] was attempted for the purpose of facilitating translation and retranslation and with the assumption that there were in Bontoc Igórot cases of the substantive, distinctions between nominative and accusative, which do, in fact, no exist: the Bontoc Igórot does not distinguish between Casus rectus and obliquus.

Later, on page 95, the author returns incidentally to the subject under the heading Future Passive:

The imperative [of the Passive] does not exist; any theoretical forms and any experimentative use of them in sentences were unexceptionally denied; "Because you cannot tell a man what shall be done to him" . . . (But the misnamed "Three Passives" (the "Genus Relativum", my Active "Possessive Verbs") were put in the Imperative without hesitation; this shows also that the *-en, -an, i-* verbs are conceived to be *Active* Nomina Agentis.)[5]

To the parenthetical clause of paragraph 218 above quoted the following is added as a footnote:

However convenient for minds trained, to some extent, in Latin, the Doctrine of the Three Passives has appeared, centuries ago, to its inventor, and however credulously his disciples clung to this perverse interpretation of the Active Verbal Noun (Nom. actionis) in Tagalog and in the dialects of several other tribes—in the Bontoc Igorot Language the Verbal Noun is certainly not passive, but active in its character.

[3] Here as in the paragraphs following I give only one of several examples. For diacritical marks used with Bontok words, compare the original. (Rev.)

[4] "Man" is but a lapsus for "our friend" (Rev.)

[5] Agentis ? (Rev.)

If a passive is wanted, there is one on hand, in all times and moods of Igorot (265–276): prefix *ma-* + root + personal endings. Experiments with the Igorot by means of their own vernacular (but not through interpreters) proved indisputably their correct consciousness of an active and a passive idea.

The fact that the Three Passives Fallacy has been propagated in good faith for about two centuries and is still indefatigably copied and republished and taught, shows (as also other factors do) how necessary it is to revise and to compare the "Artes" of time-honored "authorities" and the entire material of sacred books, catechisms, confessionals, prayerbooks, with the living dialects spoken by the natives. The result of such future careful investigations into the people's vernacular, the collection of tales and songs in the unbiased dialects of the different tribes ought to be most welcome to Comparative Philologists who seem to rely only on the unreliable material at hand, *faute de mieux*, material collected by unphilological compilers, with a few admirable exceptions, such as Totanes, Minguella.

The unfelicitous term of the Three Passives (which may have sprung from its originator's inability to distinguish between the Gerundium and the Gerundivum) was employed unscrupulously in many grammars and learned articles and papers on various Philippine dialects, Bontoc Igorot excepted. The Three Passives and their alleged application occur, for instance, in . . . [follows a list of 25 authors, titles of books, and some comment].

THE VOCABULARY.

The vocabulary contains some 2,000 English catch-words, each of which either is given one or more Igorot equivalents or is treated as a theme developed into a summary of Igorot expressions for identical and related ideas, always, however, with sharp discrimination between words indigenous to the people and those borrowed from outside. "Verbs are given first in the Present Active in their most common form (not special form); the other "principal parts" follow: Preterite—Passive Participle in Present—Nomen agentis. Personal Verbs are found in Present and Preterite only."[6] The basic form, the stem-word, of derivatives, for which comparative philologists probably will look first, is not given. The reason for this perhaps may be found in some remarks made by the author in the preface to the vocabulary: "Is it necessary to warn against using my Vocabulary any one who would, without having studied and practiced the Grammar, attempt to derive any benefit from the Vocabulary? . . . The student of the Bontoc Grammar can easily construct and supply the missing forms. The Author thinks he could do the same; but he does not intend to depart from his principle: to write down only what he has heard and as he has heard it."

THE TEXTS.

A large amount of Bontok Igorot "Text" is found scattered throughout the grammar in the shape of phrases taken down by the author from the Igorots' mutual conversation, and used by him as examples for illustrating

[6] Page 279 (Preface to the Vocabulary).

points of grammar and syntax. These phrases constitute very valuable material for gaining an insight into that "language" which springs from the mouth of the people as they work in their fields, attend to their domestic affairs, go to war or chide, scorn, laugh among themselves, etc. It is precisely because, from the intelligent use made by the author of such phrases, we can form a judgment as to the considerable insight gained by him into the spirit of the language, that we wish he had given them in the coherent form of some animated conversation among individuals of the tribe. Could any other kind of "text" reflect more truly the live speech of the people, or disclose more clearly the temperament of the speakers? By this remark I certainly do not wish to detract in the least from the great merit of the collection of folk-lore that forms the third part of Doctor Seidenadel's work and which also contains examples of spirited conversation.

These texts, eleven in number, are:

1. Lumawig, an extremely interesting and probably the most important story of Bontok folk-lore, beginning with an account of how the (Bontok) world was created and the Great Flood caused by two brothers, sons of Lumawig; how the latter bade the sole survivors, a brother and sister, located on top of Pokis Mountain, to marry, ordering his dog and the deer to furnish them the fire, etc.[7]

2. Headhunters' return and ceremonies.

3. The Igorot in the battle of Calo/ocan; a narration of the part taken by a number of Bontok men in the action between the American and Filipino forces at Caloocan, near Manila, on February 10, 1899.

4. The rat and the two brothers; a graceful legend telling of the gratitude of a rat, whose life had been spared by the younger of two brothers. The rat makes presents to them both and the younger of the two, by a cunning exchange gets possession of a magic spoon and pestle which when put into a pot will fill it with meat and rice.

5. The stars; a spicy little tale, illustrating the quick-witted inventiveness and satirical vein of the people who explain in it the origin of the Iloko tax-collectors of Spanish times.

6. Tilin; the metamorphosis of a girl into a rice-bird (tilin) as a warning to parents who begrudge their children a liberal measure of food.

7. Kolling, and

8. The monkey, two more metamorphoses of children, as a warning to parents who are too severe or neglectful.

9. Palpalama and Palpalaking; another story pointing a moral for greedy people.

10. Varia.

11. Songs; containing many words and phrases belonging to a "Song Dialect", words "of the old folks", of forgotten or obscure meaning, which are of the greatest interest to ethnologists and philologists.

Doctor Seidenadel has the merit of having overcome unusual difficulties to enrich our knowledge of Philippine languages by a work containing comprehensive and exhaustive information on the hitherto unexplored,

[7] Vaguely similar traditions exist in Ifugao folk-lore.

or at best very superficially known language of a people of northern Luzon, who upon the downfall of Spanish sovereignty were taken charge of by the American Government as crude head-hunters, and are now being prepared for entrance into the comity of their civilized brother-tribes. The compilation of an exhaustive grammar, ample vocabulary, and representative collection of texts of their language is certainly a means to bring them nearer our understanding, and to promote the task just indicated. To comparative Indonesian philology the complete representation of a member of the so-called Igorot dialects has always been a desideratum; thanks to Doctor Seidenadel this is now fulfilled and his work is already being drawn upon in furtherance of such studies.

In the interest of the linguistic exploration of the Philippine Islands it is to be hoped that Doctor Seidenadel will continue dedicating his eminent talent to a task already so greatly furthered by him.

OTTO SCHEERER.

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**Allin's Standard English-Visayan Dictionary.** By Benjamin Casey Allin, government surveyor working in the Province of Cebu, Philippine Islands. Cloth. Pp. 260. Falek's Printing House, Cebu, Cebu, P. I.

This is a handy little volume designed for the use of Filipinos who are learning English and of English speaking persons who are learning Bisaya.

As there is no Bisaya-English section it could not be used by a person who had no knowledge of English.

It contains over 5,000 English words listed alphabetically in the first column. The second column contains the same words spelled phonetically, the third abbreviations indicating whether the word is a substantive, verb, preposition, etc., and the fourth the definitions in Bisaya.

It is not quite clear why the compiler states that the letter "V" is "used only in introduced Spanish words" and yet spells the name of the language "Visayan" instead of Bisaya. There is also a good deal of difference of opinion as to the wisdom of representing by "aw" the final sound ordinarily represented by "ao." This sound in other countries where the languages are being written phonetically is represented by "au." To many this seems more nearly to represent the sound and it certainly would have the advantage, if adopted, of bringing Philippine philologists into conformity with other students of the languages of the east.

There are many typographical errors in the book but probably none of them so important as to interfere seriously with its usefulness.

One who has some knowledge of Bisaya or a considerable knowledge of English ought to find the Dictionary useful.

M. L. M.

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D. GENERAL BIOLOGY, ETHNOLOGY
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## THE FISHERY RESOURCES OF THE PHILIPPINE ISLANDS. PART IV, MISCELLANEOUS MARINE PRODUCTS.

By ALVIN SEALE.

(*From the Ichthyological Section, Biological Laboratory, Bureau of Science, Manila, P. I.*)

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### I. PHILIPPINE TREPANG (BÊCHE DE MER).

Trepang is a general name applied in the Philippines to all of the many species of animals belonging to the group Holothurioidea and known locally as *bêche de mer, balatan, bilate, munang, hisam,* sea cucumber, and cotton-spinner. Large quantities of these animals are gathered in the Philippines for export to China and Japan. Trepang is a staple food of all Oriental people and is an important item of export from the Philippine Islands.

Trepang in general appearance resembles pickled cucumbers. The

skin may be smooth, or covered with prickle-like teats arranged in rows or scattered over the body. In color they range from pale flesh-color to black. These animals, when dry, are hard, sausage-shaped, and appear to be altogether unpalatable and it is not until they have been cleaned, minced, and made into a most delicious soup by the skillful hand of the Chinese cook that the real value of this product of the sea is understood. *Bêche de mer* live among the white sand and coral in the sea-gardens and feed upon small sea-animals and sea-vegetation, so there is no reason why they should not rank as a delicious food product and come into general use among Europeans and Americans. I can, from experience, heartily recommend a trial of trepang soup[1] to those who delight in a dish free from the contaminations of the land, with a delicate aroma of the deep sea about it.

### VARIETIES OF PHILIPPINE TREPANG.

In Manila all the large dealers in trepang are Chinese. They recognize five different varieties, as follows:

*No. 1.*[2]—Oē (Plate I, fig. 1). A large, uniformly black, perfectly smooth variety (*H. atra* Jæger). This species, when dry, is from 120 to 200 millimeters in length and 40 to 60 millimeters in diameter. This is regarded as the most desirable species found in the Islands and sells for the highest price, being valued at 65 to 98 centavos per kilogram wholesale, according to the size of the animal, and care in curing. I will call it the great smooth black trepang.

*No. 2.*—Gan Sim (Plate I, fig. 2), is a large brownish trepang, with two rows of teats on each side. The animal, when dry, is of a rather flat, oval shape, about 120 millimeters in length and 60 millimeters in width. Its back is but slightly roughened. This species is regarded as being next to the best variety, sells for 40 to 80 centavos per kilogram, and is in fair demand. We will call it the great oval brown trepang.

*No. 3.*—Bark Sim (Plate I, fig. 3) is the third grade of trepang and to this belongs the great mass of trepang shipped from the Islands. It includes a large variety of forms ranging in price from 35 to 70 centavos

[1] *To make trepang soup.*—Clean and wash out the trepang in cold water, slice and put them in a chopping bowl and mince fine, soak in cold water five hours, then boil for one hour, add salt and pepper and a quantity of beef or chicken stock and bring to a boil. Serve hot. [Sing Fat.]

[2] I have been unable to find anyone in the Philippines who recognized or could give me any information regarding the names given to the Philippine trepang by Simmonds in his Commercial Products of the Sea, although I have repeatedly asked dealers and fishermen both in Jolo and Manila. It is possible that his so-called "bankolungen" is the gan sim, his "munang" the oē, his "telepan" the moi whar che, his "sapatos grande" the smooth white ringed bark sim, his "sapatos china" is perhaps the great convoluted bark sim, and his "lowalowan" is possibly the bark sim, called the small black wrinked trepang in the present paper.

per kilogram, the most abundant, perhaps, being small, black, slightly roughened, cylindrical in shape, and when dry about 90 millimeters long by 25 millimeters wide (Plate II, fig. 1). Another very common form of this grade is the Philippine convoluted trepang, a large, light brown species about 130 millimeters by 40 millimeters, cylindrical, with the body, when dry, thrown into deep folds (See Plate II, fig. 5). Another bark sim is a moderately roughened, cylindrical trepang of a dull yellowish-brown color and 150 by 35 millimeters in size (Plate II, fig. 3). Another is a dark brown, almost smooth form (when dry), with the back covered with small orange spots with black centers. This is a large species, 170 by 70 millimeters, and cylindrical in shape (Plate 4, fig. 4). I will call this the smooth white-ringed trepang. Another form very similar to the last I will term the rough white-ringed trepang. (Plate II, fig. 2.) This trepang is 160 by 48 millimeters in size, cylindrical, with the body decidedly tuberculate; it is rather dark brown in color with numerous white circles around the large tubercules of the sides and back. Another rather common trepang of the bark sim grade, is a small, very black form, with deep wrinkles in the body (Plate II, fig. 6). This variety when dry is cylindrical in shape and about 80 millimeters long by 20 millimeters deep. I will call it the small black-wrinkled trepang.

*No. 4.*—Moi Whar Che (Plate I, fig. 4). This trepang is a large, cylindrical black form, easily distinguished by the fact that the entire back is covered with numerous, very long teats which are black or reddish brown in color. This variety is quite abundant, but is regarded as fourth rate as a food product, the price being from 30 to 50 centavos per kilogram. I will term it the great prickly trepang.

*No. 5.*—Hong Che (Plate I, fig. 5) is the fifth grade of trepang, and resembles the last except that it is smaller and more cylindrical; the teats are more pointed and slightly longer. Its wholsale price is from 35 to 45 centavos per kilogram. Many of the young of the moi whar che are to be seen in this class, but are distinguished easily by their short teats. In size the hong che is from 50 to 90 millimeters in length by 16 to 20 millimeters in width.

There are numerous other grades among the 63 species of these animals found in the Philippines, but none are of sufficient importance or value to be recognized in trade. However, one very common form, called "yellow belly," is so abundant, especially about Mindoro, that is deserves at least to be catalogued. This form when dry is yellow-white on the belly and black on the back, about 60 millimeters in length and 25 in depth; its value is not above 12 pesos [3] per picul. It is only the great abundance of this grade that makes it worth our consideration.

All of the above grades retail in Manila for fully 30 per cent advance on the prices obtained by the fisherman.

[3] One peso is equal to 50 cents United States currency, and 1 picul is 139 pounds.

DISTRIBUTION, HABITS, GROWTH, AND PRODUCTION OF PHILIPPINE TREPANG.

The wide distribution of these apparently helpless, sedentary sea-animals is a matter of interest and astonishment to all who give the subject any thought. Twenty of the species found in the Philippines are also common to Polynesia, 16 to the Malay Archipelago, 30 to the Red Sea and the coast of Africa, while 3 extend even to the west coast of America. The majority of the recorded forms are believed to be well distributed throughout the Philippines, but are most abundant in the Sulu Archipelago. The supply for Manila comes chiefly from Tacloban, Polillo, and Ambos Camarines. They are found in water of various depths, even in very shallow water and also on reefs dry at high tide, down to 137 fathoms and even to much greater depth. Sheltered places inside the coral reefs where the bottom is of coral sand seem to be favorite haunts of the bark sim and hong che forms, while moi whar che, gan sim, and oê seem to prefer water of greater depth just at the edge of the reef. The greater number of the trepang appear to pass large quantities of sand and mud through their alimentary canals; from this sand they extract the small animals and plants on which they feed. On Arboles Reef, Gulf of Davao, Mindanao, I once noticed a large number of *Colochirus quadrangulus* Less. feeding on sea-weed which at low tide was about 75 millimeters (3 inches) under water. They were so abundant that it was scarcely possible to step without treading them down, and in one scoop of an ordinary dip net I secured 57 of them. It is probable that during the season for depositing the eggs they all seek the reefs or rocky crevices. Mitsukuri,[4] in his most interesting paper on the common Japanese trepang, writes, referring to the Island of Oki,

> The people there have for a hundred years or more been in the habit of putting up loose stone-piles in the shallow sea in order to obtain a supply of this trepang.

Nowhere in the Philippines is this devise put into practice although it doubtless would yield profitable results.

Practically nothing is known about the breeding time of the Philippine trepang and it is a subject well worth investigating. In Japan (as abstracted from the above paper), the trepang spawn in May and June, and at the end of the first year have a maximum size of 5 by 25 centimeters. They reach the adult condition at the end of the second year, but do not spawn until the end of the third; some individuals probably live two or three years after spawning. The young specimens are white and transparent, and they attach themselves to the roots of algæ, or seek rocky crevices in sheltered localities. Hence a rock pile affords a natural collecting ground for the very young as well as for the old. Japan has put some measures in force setting aside certain localities as

[4] Notes on the Habits and Life-History of *Stichopus japonicus* Selenka. *Annot. Zool. Jap.* (1903–06), **5**, 1–21.

breeding reserves for trepang, upon which stone piles or dikes have been constructed, and in these places fishing for trepang is strictly forbidden. In this way the Japanese hope to conserve this valuable food supply.

There are so many natural breeding places in the Philippines along the coast and among the rocks on the shore line of the many islands, that our supply now is, and probably for years to come will be, much greater than the demand, or rather more than the fishermen under present conditions will take the trouble to dry and prepare for market.

### METHODS OF FISHING FOR TREPANG.

In gathering trepang, the fisherman usually goes out at low tide wading in the shallow water, dragging a small canoe or *banca* behind him, into which he throws all the trepang he picks up; sometimes he fishes from a boat, with a long handled, one-pronged spear, with which he gathers up the trepang in water of 3 to 4 meters. In water of greater depth some fishermen dive and bring up the trepang in their hands. There are localities where small dredges undoubtedly could be used with good effect.

### PREPARING TREPANG FOR MARKET.

The Filipino method of preparing trepang for the market is to boil them for a short time (from five to twenty minutes) in fresh water, after which they are split up the belly, eviscerated, and then thoroughly dried in the sun. Each variety seems to require a slightly special treatment particularly in regard to the length of time required for boiling, in order to bring out the best flavor. However, they should all be heated thoroughly throughout, and when taken out of the boiling water they should be hard and elastic, and should dry quickly like a hard boiled egg. The oê frequently is boiled only five minutes; it should be well stirred. Experience really is the only guide as to the length of time required for boiling. Sun-dried trepang are the best, and in the greatest demand, but the method of sun-drying is too slow for preparing a whole ship-load. The following method given by V. Simmonds [5] is followed in preparing large shipments of trepang.

> The first thing to do on arriving at an island where trepang is plentiful is to erect a curing house on shore. This house may be of any desired size but one 30 meters long by 15 meters wide, with sides 4 meters high, will be found convenient for preparing a ship's cargo. This structure may be built of native material such as mats, bamboo, etc., and roofed with a coconut thatch which must be put on well to keep out the rain. A small door should be left in each end of the house. Platforms for drying the trepang are then erected along one side of the entire length of the house and these should be 2 meters wide, the lower one about breast-high from the ground and the upper one 1 meter above that.

[5] The Commercial Products of the Sea. New York (1897), 111.

These are made of split pieces of bamboo or small slats. A trench 1 meter in width and a half meter deep is then dug beneath the lower platform along its entire length, for the fires. Tubs filled with salt water are placed at short intervals along the trench, with buckets near at hand for use in preventing the fire blazing up and burning the trepang or destroying the house.

The process of curing is as follows: The trepang is first caught and gutted and washed in fresh water; it is then carried into the curing house and placed on the lower platform where it is spread out about 14 centimeters (5 inches) thick, to dry. When this platform is covered with the trepang, the fires are lighted in the trench; they must constantly be kept going, day and night, and be carefully guarded. Much skill is required in properly drying the trepang as well as in boiling it, as too much heat will cause it to blister and get porous, like a sponge, whereas too little will lead to its spoiling and turning putrid within twenty-four hours after being boiled; care is requisite likewise in gutting, for if this is not properly attended to the animals will turn into a blubbery mass within a few hours after being caught. On the afternoon of the second day after the fires are lighted, they are extinguished for a short time and the trepang is shifted to the upper platform; splints of wood should be put in those not properly drying. The lower platform is then filled again with a fresh supply of trepang from the pots, and the fires are again lighted. The trepang on the lower platform should be turned frequently during the first twelve hours. After another two days the fires are again put out and the trepang on the upper platform shoved over at one end to make room for those on the lower platform, and the same proceeding repeated for the two following days, by which time (six days in all) the first day's product will be cured properly. The trepang is then taken off the upper platform and carefully examined, those not dry are put back again, and the quantity cured is stowed away in bags on shipboard or in a dry storehouse. The product soon becomes damp unless packed in air-tight casks. If held in storage for three months, it requires to be dried again for a short time in the sun.

Forty men are necessary to work a house of the above size to its greatest capacity.

### UTILIZING TREPANG AS FOOD.

The chief use of trepang as food is in the form of a savory soup, as heretofore described. It is also eaten as a meat by certain natives of the Philippines, after it has been roasted. In some islands of the Busuanga group, the natives collect these animals and by irritation cause them to eject a viscous white fluid which swells up greatly when it comes in contact with sea-water and splits into numerous white threads, not unlike cotton; these threads are cooked and eaten and are regarded as a delicacy. However, as the animal frequently ejects almost all the viscera as well as the mucus, the dish probably would not appeal to Europeans or Americans.

The Chinese believe that trepang is not only a most delicious food, but that it also possesses excellent medicinal qualities.

### QUANTITY AND VALUE OF EXPORTED PHILIPPINE TREPANG.

Sixty-six thousand eight hundred thirty-eight kilograms of trepang were exported from the Philippines in 1909. The export in 1910 was 120,969 kilograms, which, at the low price for third grade quality, would

be valued at 51,780 pesos. As a matter of fact much of it was first and second grade trepang so that probably the true value would more nearly approximate 75,000 pesos. According to British statistics, the Sulu Archipelago alone supplied Singapore in 1907 with trepang valued at 21,975 pesos. Singapore's total trade in trepang for that period was valued at 442,102 pesos, two-thirds of which was shipped to Hongkong. It would be much cheaper for Hongkong to buy directly from Manila; as a matter of fact, our last year's increase in export largely was due to the direct buying of Hongkong dealers.

China imports each year about 3 million kilograms of trepang, chiefly from the Malay Archipelago, Philippine Islands, and the South Pacific Islands. The export from Manila might easily be doubled without damage to the fisheries.

### COMMERCIAL POSSIBILITIES IN PHILIPPINE TREPANG.

While it is true that trepang is one of the minor marine products of the Philippines, nevertheless, we should not lose sight of the fact that it is a staple and recognized article of diet with a country which has the largest population on the face of the globe, and where it finds a ready market; also, that it can be cheaply prepared, that the natural supply in the Islands is large, and that with but little care the output probably could be increased readily. Taking all these facts into consideration, it is rather a matter of astonishment that large canning companies, especially in the United States, have not awakened to the possibility of this product of the sea and added the delicious trepang soup to their list of conserved products.

A check list of Philippine holothurians appears at the end of this paper.

## II. THE SHARK-FIN INDUSTRY IN THE PHILIPPINE ISLANDS.

The drying and curing of sharks' fins (Plate III, fig. 1) in the Philippines, for export to China, is one of the minor industries, requiring but little capital and yielding profitable returns. At present the business is almost entirely in the hands of Chinese merchants.

The fins of all of the numerous species of sharks found in the Islands are used, as well as some of the fins of the larger rays. The big, dorsal fin of the shark is the most desirable; this is usually of a uniform pale grayish or whitish color on both sides, and is supposed by the Chinese to contain more gelatin than any of the others, therefore it commands the highest price and is known in commerce as the "white fin." All the remaining fins, which include the ventrals, pectorals, anal, and caudal, are classed together as "black fin." The large caudal fin when uniform in color is frequently put in as "white fin." The fine white fins are selected for the making of soup, while the black fins are largely used in manufacturing a superior grade of fish glue.

### METHOD OF CATCHING SHARKS.

Sharks are principally caught by the Moros, although they are captured in considerable numbers in corrals and nets throughout the Islands. The Moros usually spear them, or catch them with hook and line, using stale fish for bait. The observer can not fail to be impressed by the number and size of the sharks caught by the Samal Moros in the vicinity of Sitanki Island.

A number of Philippine sharks will take the trolling spoon, especially if it is painted red on one side; they afford very good sport. In India, sharks are captured in large nets for the sake of the oil secured from the liver; they are also used as food by the poorer classes. In the Philippines the Moros alone seem to relish shark-meat, and the manufacture of fish oil is an entirely neglected industry. If we consider the great number of sharks caught in these Islands, it is a matter of surprise to find that the making of fish-oil is not carried on in connection with the shark-fin industry, as this would very materially increase the revenue derived from each shark.

### THE PREPARATION OF SHARKS' FINS.

The fins are cut from the shark as soon as possible after its capture, the thick fleshy portions of the larger fins are slit open to facilitate their drying, and they are then spread out in the sun. It requires from three to six days to dry the product depending upon the amount of sunshine. After the fins are thoroughly dry they are assorted into two grades: The white fins, or first class variety, in which are placed all the large dorsal fins; and the black fins, or second class, which includes all the small fins. They are then packed tightly in bales of about 100 kilograms each and are ready for export.

These fins are further prepared by being soaked in boiling water for a short time and the skin removed. They are then shredded into small cartilaginous rods, somewhat resembling a very fine grade of sphagetti. These are waxy white and attractive in appearance (Plate III, fig. 2).

At this stage they are either made into soup, or dried and reëxported to all parts of the world at considerably more than double the original price. To make this prepared fin into a savory and wholesome soup it is soaked in cold water one day, then placed in hot water for one hour, this causes all the rods to separate. Eggs and some chicken or beef stock, salt, pepper, and butter are added and the mixture boiled for two hours. That the above receipt produces a most delicious soup was the unanimous verdict of the staff of the Bureau of Science after testing a sample prepared by Sing Fat, a well known Chinese cook of Manila.

No great Chinese feast is complete without a dish of this soup and I believe it is worth while to call the attention of our large soup manufacturing establishments to the possibilities of this industry in the Philippines. I believe that an almost unlimited market could be found in China.

### THE AMOUNT AND VALUE OF SHARK-FIN EXPORTED FROM THE PHILIPPINE ISLANDS.

Sharks' fins weighing 172,610 kilograms, valued at 85,000 pesos (42,500 dollars), were exported from Manila during the year 1910. The current price of shark-fin at Zamboanga, which is one of the centers of the trade,

is 84 centavos per kilogram for the white fin and 58 centavos for the black, therefore, it is evident that the export valuation is very low and that the real value probably would be somewhat over 100,000 pesos. The price is subject to considerable variation. In 1909 the maximum price paid for the entire yield was 2.19 pesos per kilogram including both white and black fins. Chinese merchants in Zamboanga informed me that the price for the first grade white fin sometimes reaches 6.58 pesos per kilogram, but this is unusual. Almost the entire yield of Philippine shark-fin is shipped to Singapore or Hongkong, and from these places is distributed to various parts of China.

In Manila the retail price of prepared shark-fin, as shown in Plate III, fig. 2, is from 8 to 10 pesos per kilogram.

In conclusion I wish again to call attention to the fact that the by-products of the shark fishery are entirely wasted. If, in addition to the fins, the liver was used to make fish oil, and the skin which is used for scabbards for swords was also saved, the revenue derived from each shark would be about doubled.

## III. PHILIPPINE SEA TURTLES AND TORTOISE-SHELL.

### VARIETIES OF PHILIPPINE MARINE TURTLES.

Sea turtles of large size find a congenial home in the warm waters of the Philippines. Abundant schools of fish supply them with plenty of food, and the hot sandy beaches of numerous, small, uninhabited islands furnish them ideal nesting places; hence, as a result of these conditions, the three recognized species of sea turtles are found throughout the Archipelago.

The marine turtles [6] are easily distinguished from all other kinds by the fact that their limbs have become completely changed into paddles, the fingers being entirely encased in a single skin, with one or two claws only projecting. They swim swiftly in the sea, but are almost helpless on the land, and if turned on their backs they can not regain their normal position.

Our most important sea turtle, popularly known as the hawksbill turtle, is *Chelone imbricata* Linn. (Plate IV, figs. 3 and 4), which supplies the tortoise-shell of commerce. It is easily recognized by the fact that it has a hooked bill (Plate IV, fig. 4) and but 13 plates on the back, which overlap like the shingles on a roof; in addition, there are 25 small plates which form the margin of the back. This turtle feeds largely on fish, crabs, and mollusks, and when full-grown is about 1 meter in length.

[6] All members of the turtle family that live in the sea are called turtles; those living on the land only are termed tortoises; and those living in fresh water terrapins.

The green turtle (*Chelone mydas* Linn.) is next in importance. (Plate IV, fig. 5.) This turtle has a straight bill (Plate IV, fig. 6), but the shields on the back, while the same in number as in the hawksbill, are perfectly smooth, evenly joined, and do not at any stage overlap. This turtle is valued chiefly as food, the shell being of no value. However, as an article of food it has from time immemorial been considered a great delicacy. This species is herbivorous, and when adult it is about 1.25 meters in length. The flesh may be cooked in any desired way, either roasted, used as soup, fricasseed, or made into stews or pies. The following method of cooking the plastron, or shell of the belly, is given by Father Labat, a Dominican monk.[7] It sounds so appetizing that I give it in full.

> The plastron or bluckler is the shell of the belly, on which is left three or four inches of flesh, with all the fat, this being green, and of a very delicate flavour. The plastron is placed in the oven. It is seasoned with lemon, capsicum or cayenne, salt, pepper, cloves, and eggs beaten up. The oven ought not to be too hot, as the flesh of the turtle being tender it should be cooked slowly. While it is baking the flesh must be pierced from time to time with a wooden skewer, so that the gravy may penetrate all parts. The shell is sent up to the table and the meat carved out from it. I have never eaten anything more appetizing or better flavoured.

There are large factories in various countries that can the soup made of this turtle.

The third variety of marine turtle found in the Philippines is the loggerhead (*Thalassochelys caretta* Linn.) (Plate IV, figs. 1 and 2). This species is easily distinguished from either of the above from the fact that it has 15 shields on the back and 27 around the margin of the shell. The jaw is strongly hooked (Plate IV, fig. 2). It feeds on crabs and other crustaceans. The shell is about 1.25 meters in length when full-grown. The shell practically is of no value, being almost as thin as paper (Plate V, fig. 4), and it is only used for veneering and inlaying work. The price for which it sells is from 2 to 4 pesos per kilogram. However, the animal supplies a large portion of the turtle oil of commerce.

### TORTOISE-SHELL.

During the fiscal year 1909 there were exported from the Philippines 2,040 kilograms of tortoise-shell valued at 34,942 pesos. During the year 1910 the exportation fell to 1,191 kilograms, probably owing to home buying and domestic use.

The hard, bony plates which cover the back (carapace) of the hawksbill turtle are the tortoise-shell of commerce (Plate V, fig. 1). There are 13 of these plates on the back of each turtle, 5 in the center and

[7] Simmonds, Commercial Products of the Sea. New York (1895), 367.

4 on each side. In commercial terms these are known as 8 "sides," 2 "hoofs," 1 "skull," and 2 "main" plates. The two middle side-plates are of the greatest value, being the largest and thickest. Plates 17 by 30 centimeters in diameter with a thickness of 5 to 6 millimeters are not unusual in the Philippines. In addition to these large plates, there are 25 small ones around the margin of the shell; these are known as "hoofs" and are of much less value. All of the plates together are known as a "head" of shell, and tortoise-shell nearly always is sold by the "head."

Practically all the Philippine tortoise-shell is brought into the market by native fishermen. Now, while a small number of these turtles is captured by fair means, with hook, net, spear, or trap, by far the greater number is taken when they come ashore to deposit their eggs. The fishermen are so eager to secure their prizes that as a rule they do not give the poor turtle a chance to deposit her eggs before they kill her. This short-sighted policy eventually will result in the destruction of the fisheries unless the turtles are protected during the breeding season, which is from May to August. The turtle fishermen go to small, uninhabited islands, frequently many miles from the large islands surrounding the Sulu Sea, and wait perhaps days for the turtles to come ashore to deposit their eggs. If the men are in no especial hurry they may wait until the turtle has deposited her eggs, which sometimes are 150 to 200 in number, and about the size of hens' eggs, with tough leathery shells. The fishermen then kill her before she can reach the water, and dig up the eggs which they use as food. The islands of Bancoran, Lumbucan, Arena, Cavilli, and others in the Sulu Sea, are well-known nesting places of the turtle, and it is only necessary to visit these islands to see the destruction wrought during the nesting period.

The best method of removing the tortoise-shell from the back of the turtle is to immerse the back in boiling water until the shell loosens; another method is to bury the body in the sand for eight days, when the shell becomes loosened; still another is to hold the shell over a slow fire until loosened. This latter process usually is employed. In some countries the live animal is held over the fire until the shell is loosened; it is then turned loose "to grow another shell." This method is barbarous, not only for its cruelty but also for its lack of utility, for the animal promptly dies.

### WORKING AND WELDING TORTOISE-SHELL.

The methods employed in the working of tortoise-shell are quite similar to those used in working horn. As a matter of fact, horn frequently is used as an imitation of tortoise-shell. Slow heat or steam is employed, the shell becoming plastic by immersion in water of 90°C. for two minutes. When cool, it retains any shape given it while hot.

The exact technique [8] of welding tortoise-shell is as follows:

When two pieces of shell are to be joined, the two edges are beveled so that one inclined edge may lie upon the other. The edges are scraped perfectly clean, contact with the fingers or any greasy substance being carefully guarded against. A piece of paper is then bound around the overlapping edges and fastened with a string. A pair of flat tongs or pincers, something like hair-dresser's tongs, are then heated and applied to the shell, one jaw of the pincers above and the other beneath, by means of which the shell is grasped throughout the length of the seam or overlap. By holding it a short time in this position, the heat of the iron penetrates through the paper, softens the shell, and causes the two pieces to unite firmly. Sometimes two pieces of shell are united by means of boiling water as follows: The two edges are overlapped, two pieces of metal are placed along the joining, the shell is placed in a press, and the whole is immersed in boiling water. As the shell softens, the press is screwed more tightly, by which the two pieces of shell become firmly united. Owing to the fact that the shell becomes mobile with heat, it is easily molded into almost any desired shape by means of boiling water and the screw press, and even small bits of shell are utilized by being thus welded together. If too much heat is used the shell becomes blackened, consequently in many places, especially in Japan, most of the work is accomplished by hand graving, following a pattern as in scroll work. The same method is followed in Manila, where the outfit of the workman consists simply of scraper, saws, files, and a bench. Manila has two small factories employing about six men (all Chinese), where crude combs (Plate VI, figs. 1 to 6) of tortoise-shell are made. There is also a small factory in Iloilo. All the work in this place is done by hand and is of the crudest sort.

The method used to weld tortoise-shell in Japan differs in slight detail. Dr. Shigeho Tawaka of the Zoological Institute, College of Science, Imperial University of Tokyo, kindly supplies the following information.

First of all, shells which are to be welded are just dipped in water and thus moistened, the shells are then put in between two thin pieces of magnolia wood (*Magnolia hypoleuca*) and then the whole thing is moderately pressed with a pair of heated pincers which have been dipped in water an instant before operating (a hissing sound is the usual sign of these being sufficiently heated). The welding of the shell is thus completed. The reason why they use the magnolia pieces is to avoid the direct contact between the heated pincers and the shell. The temperature of the pincers is not scientifically made known, being said to be the trade secret kept among the preparators.

The appearance of tortoise-shell frequently is given to horn by brushing it over with a paste made of two parts lime to one part litharge, and a little soda lye, which is allowed to dry on. Artificial tortoise-shell is manufactured by melting gelatine and various metallic salts.

### VALUES AND GRADES OF PHILIPPINE TORTOISE-SHELL.

It is very difficult to arrive at a true valuation of tortoise-shell, owing to its variations and the reluctance of the Chinese merchants, who now control the trade, to give out any facts regarding the matter, but 4 different grades are

[8] Simmonds, Commercial Products of the Sea. New York (1895), 355.

recognized. Two of the principal merchants of Zamboanga give the value of the first grade (which is not often found), as 50 pesos per kilogram while 2 principal dealers in Balabac quote the value of the first grade at 167 pesos per kilogram. These prices were quoted to customs officials. The value of the second grade is from 16 to 20 pesos per kilogram. A considerable portion of the Philippine shell falls in this grade (Plate V, figs. 1 and 2). The third grade is thinner and is valued at from 11 to 13 pesos per kilogram, while the fourth, consisting of small shell is valued at 4.16 to 8 pesos per kilogram. It usually is sold by the *catty*, which is equal to 1.39 pounds.

The value of tortoise-shell depends not only on the size and thickness of the plates, but also largely upon the coloring and marking, there being a great variation in the beautiful clouded and mottled patterns in the shell. The color most in demand at present seems to be the rather dark shell with but few light spots. Golden-colored combs, at one time greatly prized and to-day much used by ladies with blond hair, are made from the plates of the plastron or belly. The price of the shell also depends largely upon the prevailing style in ladies' hair dressing as well as upon the fashion in toilet articles. However, the demand for good tortoise-shell seems steadily to be increasing. Japan is the center of the work for oriental countries.

### POSSIBILITIES OF TORTOISE-SHELL WORK IN THE PHILIPPINES.

Personally I have seen nothing in the Philippines which seems to offer so sure a return to a man with a small amount of capital, say 6,000 to 10,000 pesos, as the buying and working of tortoise-shell. The machinery required is but little. The manufactured articles would enter the United States duty free, thereby finding a ready market. The supply of shell is, on the average, about 2,000 kilograms per year, which would be sufficient to keep a small factory in operation and I have no doubt that the returns would be remunerative. The main difficulty would be to induce the Chinese middlemen to deal directly with the factory rather than with Shanghai or Singapore (the two places that take practically our total yield). A man who could buy directly from the fishermen would have a still larger profit.

### CULTIVATION OF THE TORTOISE.

The cultivation of the hawksbill turtle has never been undertaken in the Philippines, but it is not improbable that it could be cultivated to advantage in much the same way as is the edible turtle (*Tryonyx japonicus* Schlegel) in Japan. It is a subject worthy of consideration not only by private individuals but by the Government. A careful study of the habits, nesting places, rate of growth, and food of the hawksbill and green turtles should be undertaken with artificial cultivation in view, and if thought practical, steps should be taken to establish turtle farming, for practical and experimental purposes.

## IV. THE PHILIPPINE WINDOW-SHELL.

### DESCRIPTION.

In the majority of windows in the city of Manila, the pane is of shell instead of glass. The shell used for this purpose is called *kapas* or window-shell (*Placuma placenta* Linn.).

This shell (Plate VII, fig. 2) is thin and flat with a rounded outline, and somewhat resembles a very large wafer. The entire shell including the animal is about 1 centimeter in thickness (Plate VII, fig. 1) by 14 centimeters in diameter. The left side (valve) of the shell is slightly convex, the right side is flat. The right side is easily transformed into a windowpane simply by squaring off the edges with a big pair of scissors or a crude machine such as is used for cutting plug tobacco. The shells are then framed and are ready for use. The size of shell most in demand will square 7.5 centimeters, although those that square 6.5 centimeters are also much used. The opinion prevailing among the general public regarding window-shell is that it is a slab of shell split off from some larger shell. This, needless to say, is entirely erroneous, as the window-shell is used in its natural condition, the two halves being torn apart and the edges merely trimmed. The left side of the shell is convex and hence is in but small demand. Windows made of these shells are translucent, admitting a soft light, very grateful to the eyes in a tropical country.

The windows present a most attractive appearance (see Plate IX, fig. 1) and consequently are used in some of the handsomest structures in Manila, such as the American Cathedral, the new General Hospital, and the new Young Men's Christian Association building; and while they increase considerably the beauty of this type of architecture, they are also peculiarly adapted to, and make a most attractive appearance in, buildings of the bungalow style.

### DURABILITY AND STRENGTH OF THE WINDOW-SHELL.

These windows of shell last for generations. Some of the old churches of Manila have shell windows which have been exposed to the weather for over a hundred years and which are still serviceable. Shell windows are easily repaired, as a new shell is readily sprung into place when one becomes broken or worn.

The strength of these thin, wafer-like shells is something astonishing. Below is given a table showing the relative strength of window-shell as compared with plate glass 2 to 3 millimeters in thickness by actual test in the Bureau of Science.[9] It is shown by this table that window-shell is much stronger than plate glass 3 millimeters in thickness. The

[9] The tests were made by W. C. Reibling of the laboratory of inorganic and physical chemistry, Bureau of Science.

relatively poor showing of the Capiz shells probably is due to the fact that they were old and very dry; they also were somewhat smaller than those from Cavite.

*Table showing the strength of window-shell compared with plate glass.*

| Material tested. | Average thickness. | Average weight per square cm. | Number of falls of a steel ball weighing 3.55 grams, necessary to produce failure on samples 2.54 cm. wide and supported at both ends 5 cm. apart. Height of fall. 50 cm. | 100 cm. | 150 cm. | Number of blows necessary to produce failure with 1 kg. weight with a rounded striking end falling 1 cm. high on specimen 7 by 7 cm. and supported at both ends 6 cm. apart. |
|---|---|---|---|---|---|---|
| | *mm.* | *gms.* | | | | |
| Capiz shells | 0.8 | 0.162 | 50, not broken | 6 to 61 | Two | 6 to 73. |
| Cavite shells | 1.1 | 0.227 | do | 50, not broken | 50, not broken | 390 to 1,500. |
| Glass | 2 | | do | One | | 1. |
| Glass | 3 | | do | do | | 2. |

GENERAL ANATOMY OF THE WINDOW-SHELL.[10] See Plate VIII (a-l).

These shells when alive are more or less transparent and in younger specimens the functions of the animal may readily be observed through them. Old specimens are thickened and opaque.

The largest and most striking object that attracts attention upon opening a window-shell is the mantle, or pallial lobe (Plate VIII, fig. a), which lines the interior of the shell, the margin of which has numerous, fine, finger-like projections forming the pallial fringe (fig. b); the mantle usually is much pigmented. When the left valve is removed and the left pallial lobe cut away, the 4 scimitar-shaped gills or branchiæ are exposed (fig. c). Near the center of the shell is the round, hard adductor muscle (fig. d) which has been cut in order to open the shell. Directly above the muscle, surrounding the stomach, is the large, yellowish-green liver (fig. e); directly to the right of this is the large, yellow, genital lobe (fig. f); originating just above the highest point of the gills is the foot (fig. g), a long tube-like organ extending to or beyond the edge of the mouth and ending in a disk which is usually full of mud. On the opposite side of the shell is seen a structure slightly similar but much smaller and ending in a disk; this is the anal funnel (fig. h). The intestine extends up to the stomach. Near the base of the foot, between two, thin, flap-like membranes, the labial palps (fig. i), is found the small, slit-like mouth. Between the lower genital lobe and the muscle will be seen a delicate, thin-walled organ, the heart (figs. j and k), consisting of 2 auricles and 1 ventricle. The aorta, with some of its large branches, is on the top of the liver. To the left and near the muscle are the kidneys, or nephridia (fig. l); dark colored, elongate organs. By dissecting between these and the muscle, a long, curved, cartilage-like rod is exposed. This is the crystalline style; it is inclosed in a sac, the pyloric cæcum.

[10] For a detailed and accurate account of the anatomy and histology of *Placuma placenta* L. we refer the reader to the excellent work of James Hornell, F. L. S., of the Madras Fishery Bureau, in a Report to the Government of Baroda on the Marine Zoölogy of Okhamandale in Kittrawar, Part I (1909), 43-99, 5 pl.

The nervous system is similar to that of other members of this order, being composed of the following three ganglia: (1) The cerebral ganglion may be seen by folding back the labial palps; it is a large, pale, orange-colored mass halfway between the base of the palps and base of the foot. (2) The pedal ganglion is on the base of the foot in the middle on the dorsal side. (3) The parieto-splanchnic ganglion will be found on the lower front curvature of the muscle close to the extremity of the kidneys. The byssus and byssus gland are absent.

### DISTRIBUTION OF THE PHILIPPINE WINDOW-SHELL.

The window-shell is widely distributed throughout the Islands in certain definite areas. A large bed exists in Manila Bay, especially in the shallow arm of the bay east of Cavite known as Bacoor Bay. It is also found at Parañaque; in fact, the entire east end of the bay from Parañaque to Cavite is a potential bed for the window-shell. Kawit is the center of activity for window-shell fishing for the Manila Bay beds. Important beds also occur at Pangolao and Talibon in Bohol, at Valladolid in Oriental Negros; in Capiz, Masbate, and Iloilo; in the Province of Pangasinan, Luzon, and in numerous localities in Mindanao. Doubtless, there are a number of other places in the Islands where this shell is found which have not been reported. Iloilo supplies large quantities of shell for the Manila market. Shells from the Province of Pangasinan seem to be uniformly thicker and more opaque than Iloilo shells, but average slightly less in size, being 112 and 107 millimeters in diameter.

In no place in the Philippines are these shells fished for the pearls which they sometimes contain, but always for the shell alone.

### HABITS, CULTIVATION, AND FOOD OF THE WINDOW-SHELL MOLLUSK.

The window-shell mollusk is usually found in shallow water, but has been known to exist in a depth up to 20 fathoms. It requires a bottom of grayish or bluish mud where more or less fresh water is carried in by streams.

There is a large variety of marine life found in the Manila beds, such as large quantities of clams and edible oysters; in fact, the cultivation of the oyster and the window-shell is carried on simultaneously by a number of fishermen. The oyster beds are staked off by their respective owners, and when fishing for window-shell or oysters outside of their claims, all the small and half-grown window-shell oysters are collected and planted on their oyster farms and kept there until they are mature. The young shells can not be sold as they are not large enough for windows. The adults keep the claim well supplied with spat.

The owners of these claims club together and hire a watchman, who is stationed in a house built over the water near the claims.

The yield of the Cavite beds is estimated at 14,000 adult shells for a good week's fishing. However, the fishing is intermittent, depending upon the demand and also upon the owner's need of ready cash. The shells are fished entirely at low tide in water of 1 meter or less in depth; the fishermen feel for them

either with their toes or their hands, just as the fancy strikes them. Adult shells are rather scarce on the public fishing grounds of these beds. I secured but 35 in one hour of fishing, but in ten minutes an owner of one of the planted beds secured 100 adult shells for me. These measured 118 to 135 millimeters in their greatest diameter.

The shell matures in three years. At the end of the first year it is 62 to 83 centimeters in its largest diameter. The sexes are separate, the eggs being fertilized in the water. The mature ova have a decided resemblance to the form (in outline) of the mature shell, while the spermatozoa have globular-shaped heads and extremely long tails, fully 10 to 15 times the length of the head. It is a comparatively easy matter to fertilize the ripe ova under artificial conditions by taking the ripe spermatozoa of the male in sea-water or normal salt solution.

The artificial fertilization and cultivation of this important commercial mollusk is well worth our careful consideration, and it is to be hoped that with the opening of the salt-water aquarium and fish hatcheries having running salt water, that the study of the life and cultivation of this shell will be made with great care and detail.

The food of the window-shell mollusk consists of small marine organisms, chiefly diatoms, which it collects from the water. The window-shell mollusk apparently does not move about, but lies flat on the mud on its convex, left side. The foot, instead of being a means of locomotion, is used to keep the mud from the gills and other organs.

QUANTITY OF SHELL AVAILABLE AND PRICES DEMANDED.

The supply of this shell in the Philippines is so large that at no place has it been found necessary to resort to diving for it, as is done in India, as plenty of shell is secured by wading in water less than 1 meter in depth and feeling about with the toes.

There are no laws regulating the gathering of window-shells, and so far as we have been able to ascertain there are no municipal ordinances relating to them.

It is estimated that there are 5,000,000 of these window-shells used each year in the City of Manila alone. A single lumber company of this city in 1910 used 1,500,000. The demand is increasing.

The price depends upon the size. Shells that will square 63 millimeters (2.5 inches) sell for 3 to 7 pesos (1.50 to 3.50 dollars) per thousand; while the large ones which square 7.5 centimeters (3 inches) sell for 8 to 10 pesos (4 to 5 dollars) per thousand. One window-shell fisherman explained to me that he had three prices for the first-grade shells. These were valued at 8 pesos per thousand to the Filipino, 10 pesos per thousand to the Spaniard, and 12 pesos per thousand to the American.

The Chinese traders do not hesitate to ask the amateur buyer 15 pesos per thousand. The shells usually are sold in large baskets, each holding 10,000 pieces.

The window-shell is not exported to any extent, the only shipment for last year being 1,458 kilograms sent from Iloilo to New York. However, it is expected that when the builders of bungalows in the United States, especially in California, recognize how much stronger, cheaper, and more attractive these shell windows are than the same thickness of glass, there will be a brisk demand for them in that country.[11]

### HOW WINDOW-SHELL IS USED.

Shell windows are made of narrow strips of wood usually 13 to 18 millimeters wide and 13 millimeters thick, or they may be any size desired. These strips are grooved on two sides and notched every 6.0 or 7.5 centimeters as the case may be, to receive the cross stick which also is notched; thus a solid square frame is formed for each shell. After these are put together the entire square is set in a solid frame to fit the window or door. (Plate IX.)

The following uses are also suggested for the shell:

*Screens.*—(Plate IX, fig. 2.) These shells make a most attractive and useful screen, made up either in three divisions in the usual form of the Japanese screen, or else in a single division like the Spanish screen.

*Lights for verandas.*—(Plate I, figs. 1, 2, and 3.) These shells make a most durable and desirable light for open verandas, as they lend themselves to a great diversity of forms, the shell being easily trimmed to fit into any form of opening. The old-fashioned lantern shape is a popular form for these lights.

*Old mission shade lights* (Plate X, fig. 3) are most attractive and serviceable; they are usually made up with hard-wood frames and large window-shells.

*Conservatory windows.*—These shells would be found most desirable by the owners of hot-houses or conservatories in countries where hail is prevalent or where the direct rays of the sun are too strong; they admit a soft light with a fair amount of heat, and the expense as compared to that resulting from breakage and painting or frosting of glass would be almost nothing.

*Fronts to kitchen cabinets.*—These window-shells would make up into most attractive fronts for kitchen cabinets, being easily kept clean and not liable to breakage.

A dozen other uses might be suggested for window-shells. We can most highly recommend them for almost any purpose to which opaque glass would ordinarily be applied, and I feel confident that, when their cheapness and utility are recognized in the United States, they will be exported in larger quantities.

## V. PHILIPPINE SHELLS USED IN THE MANUFACTURE OF PEARL BUTTONS.

In addition to the pearl-oyster shells, which are exported from the Philippines in large quantities,[12] there are three varieties of shells found in these Islands and used in the manufacture of pearl buttons. These

[11] Names of Philippine dealers from whom window-shells may be obtained in quantity, can be obtained by applying to the Bureau of Science.

[12] See *This Journal, Sec. D* (1910), 5, 87 to 101 (with 6 plates).

are the great top shell (*Trochus niloticus* Linn.), the green snail (*Turbo marmoratus* Linn.), and the chambered nautilus (*Nautilus pompilius* Linn.).

### THE GREAT TOP SHELL.

The great top shell (*Trochus niloticus* Linn.) (Plate XI, figs. 1 to 4) known locally as the lock, conic shell, trochus, *susong-dalaga,* or *samong,* is a large, conical, top-shaped shell, found in abundance in many islands of the Philippine Archipelago. Aside from the true pearl oyster, this shell is the one in greatest demand for manufacturing buttons. As a matter of fact, owing to its cheapness, it is frequently made into buttons in preference to employing the pearl oyster. The great top shell when mature is from 10 to 15 centimeters in diameter and a trifle less in height; it has many close whorls, the largest of which flares decidedly. The shell is marked with radiating or zigzag bands of red, violet, or brown; the aperture is oblique and has a spiral operculum. An adult shell 10 centimeters in diameter weights 330 grams.

The great top shell is usually found at low tide near the outer edge of coral reefs or under large rocks, and while small quantities may be encountered on almost any coral reef in the Archipelago, they are especially abundant in the vicinity of Sitanki, along the coast of Pangasinan, and Ambos Camarines, Luzon, and on the northern coast of Palawan, the eastern coast of Samar, and in the vicinity of Masbate. There are also numerous places on the coasts of Mindoro where they are abundant. I noticed a number of these shells washed up on the beach on the eastern side of the Gulf of Davao.

The soft portion of the great top shell is regarded by the Filipinos as a very fine article of food and, as a matter of fact, this species of mollusk is more sought after for its meat than for its shell. One proof of this is in the numerous piles of empty shells to be found on the beach in localities near the ocean. It is usually noticed that they have been placed on the fire, in order to cook the animal, after which it is easily removed from the shell. Of course, shells treated in this manner are spoiled so far as their commercial value is concerned. The proper way to remove the animal is to place the shell in hot water, as the shell is in no wise injured by this treatment.

So far as my experience shows, the great top shell is always more or less solitary and while five or six are frequently found under one large stone they never occur in beds or in great numbers over a given limited area.

The average annual export of this shell from the Philippines during the past four years has been about 350,000 kilograms valued at about 60,000 pesos. The price fluctuates greatly. For a considerable period the standard price was 7.50 pesos per picul for middle grade shells. The Manila

button factory, in 1910, was paying from 10 to 22 centavos per kilogram, depending on the grade. A small quantity of shell sent to the United States was sold for about 22 centavos per kilogram (5 cents gold per pound). Japanese button factories offered to buy, in large quantities, half-grown shells for 28 pesos per picul of 137.5 pounds. During May the price for great top shell in Zamboanga was 18 pesos per picul. During the past few weeks the price has fallen to 12 pesos.

The establishment of a second button factory in Manila, together with the evident desire on the part of American button factories to secure Manila shell, no doubt, are responsible for the increase in the price. The result will certainly be greatly beneficial to the trade as it will stimulate the gathering of these shells and the native fishermen will soon learn that it is more profitable to bring them to market than to destroy them by fire in order to extract the animal for food.

The one objectionable feature which must soon be taken into consideration is the desire of the Japanese buyers to secure the young, half-grown shells. It is very evident that if the young shells are taken it will not be long before there are none left to propagate. However, this is a condition that may easily be remedied by legislation. An adequate export duty on great top shells of less than 9 centimeters (3.5 inches) should be imposed at the earliest possible date.

No careful study has been made in the Philippines of the reproduction, habits, rate of growth, food, or the possibilities of artificial cultivation of this commercially important shell.

### THE GREEN SNAIL SHELL.

The green snail shell (*Turbo marmoratus* Linn.) (Plate XII, figs. 1 to 4) known locally as turbo, sea snail, *lalong*, or *bulolo*, is a large, heavy, turban-shaped shell, found throughout the Philippine Archipelago, and largely used in the manufacture of buttons. It is not in as great demand as the great top shell, as it is considerably harder to work, and of less desirable color, having an opalescent instead of a pure white luster.

The green snail is the largest of the turbo family, sometimes reaching a diameter of 20 centimeters. The usual size is about 16 centimeters; the whorls are few, more or less knobbed; the body whorl is the largest; the aperture is nearly round.

The color of the shell is a rich green, mottled or spotted with brown and white. The very old shells lose much of the brown color, and show continuous bands of white following the whorls. When the rough outer layer is removed they are of a beautiful, opaline mother-of-pearl color inside and out.

In addition to being made into buttons they are also a favorite shell for cabinets, spoons, and drinking horns. The royal family of Scandinavia from time immemorial have had these shells studded with gems, mounted with silver, and formed into royal drinking cups.

The animal is highly esteemed as food by the Filipinos and is eaten in Japan also, where it is made into *chop suey*.

The green snail is found in the greatest abundance at the edges of coral reefs and in water several fathoms deep. It is also to be encountered along rocky shores under large boulders. The small islands in the vicinity of Cebú yield a considerable quantity. It is also fairly abundant along the coast of Negros and Masbate. The northern coast of Palawan also yields a large supply.

About 100,000 kilograms of the green snail shell are exported from the Philippines annually. The price paid to the fishermen ranges from 7.50 to 11 pesos per picul of 63.25 kilos.

As in the case of the great top shell, very little is known of the life history, habits, reproduction, or the possibilities of artificial cultivation of this shell in the Philippines.

### THE CHAMBERED NAUTILUS.

The chambered nautilus (*Nautilus pompilius* Linn.) (Plate X, fig. 4) is so well known that a description is unnecessary. It is world-wide in distribution and is an inhabitant of water of from 300 to 350 fathoms in depth. China seems to be the only country that manufactures this shell into buttons, consequently its export from the Philippines is practically limited to that country.

The chambered nautilus is obtained in large numbers along the southern coast of the Island of Negros, sometimes as many as 3,000 nautilus shells being gathered in this region during one season. They are frequently caught in fish traps and are sold as a sort of "by-product" at 10 centavos each, although when brought into market the very fine, large specimens sell for much more. In many countries these shells are fashioned into spoons, vases, and pearl ornaments. A practical as well as an ornamental use has been made of these shells by the author, who has them mounted on red coralline, set in a solid base of red cement and with an electric globe fitted to the inside of the shell. This makes a most satisfactory reading lamp. (Plate X, fig. 4.) In Paris these shells are used for making the finest grades of cameos, and ornamental objects of pearl. They are among the most striking common shells in all museum cabinets. In New York City dealers charge from 2.50 to 5 dollars each for fine, large shells. Unfortunately the New York market is limited.

However, there is an increasing demand for these shells for the purpose of export, and some fishermen are found who give their entire time to catching nautilus. Ordinary bamboo fish-traps with funnel-shaped entrances are used. These are baited with crab and lowered into deep water, in a day or two they are drawn up and the nautilus removed. The Filipinos eat the flesh to a limited extent.

### SUGGESTIONS FOR ESTABLISHING BUTTON FACTORIES IN THE PHILIPPINES.

Judging from the numerous letters of inquiry received by the ichthyological section of the Bureau of Science from various parts of the world regarding the establishment of button factories in the Philippines, this

is a subject of sufficient interest to warrant giving the following suggestions:

*Location of factory.*—Manila, Cebu, Iloilo, or Zamboanga would be a good place for the establishment of a button factory. The cost of renting a suitable building for a factory in either of these places would not exceed 50 dollars per month. A building would cost somewhat more than a similar structure in the country or coastwise districts in the eastern United States.

*Labor.*—The laborers would be Filipinos. They are found quite satisfactory by the Manila button factory, the pay in this factory being from 5 to 10 pesos per month, ten-hour days.

*Power.*—Steam or gasoline power would probably be found most satisfactory, although in all the places mentioned, except Zamboanga, electric power could be obtained. Wood as fuel is quite out of the question; coal costs from 10 to 14 pesos per ton in Manila. At Zamboanga water-power might be secured. Gasoline in Manila sells at from 4.50 to 5.00 pesos per 10 gallons; petroleum costs 1.40 pesos per tin of 5 gallons.

*Taxation.*—A manufacturer's license, costing 2.40 pesos, is required, and the internal revenue tax is one-third of 1 per cent of the gross receipts, payable quarterly.

*Amount of shell available.*—The amount of shell available for button making is about 450,000 kilograms of great top and green snail shell and 300,000 kilograms of pearl shell, making a total of about 750,000 kilograms (1,675,000 pounds) of shell per year.

*Bleaching shell for button making.*—A large portion of the button trade is with the Chinese and they require a very white button, consequently a bleach of some sort is necessary. The following method, given by Robert R. Williams of the laboratory of organic chemistry, Bureau of Science, is effective and cheap.

"Many processes are in existence for the bleaching of ivory, horn, and shell for ornamental or other purposes. When chemicals are used those having a solvent or oxidizing action on the organic matters in the horn or shell are chosen. Nowadays the most commonly used agent is hydrogen peroxide which may be had very reasonably in Europe and America. It is not feasible to use it at a distance from the factories making this chemical because of the deterioration in transit. Therefore it is more practicable to use a metallic peroxide and generate the hydrogen peroxide when needed. Barium or sodium peroxide may best be used, preferably the latter. The following process has been tested on shell buttons and found satisfactory. The buttons are first immersed in fuming sulphuric acid for ten to fifteen minutes. The acid is then drained off and may be used repeatedly if kept in well stoppered bottles. The buttons are then rinsed three times with water and covered with a 5 per cent solution of oxalic acid. Ordinarily 1 liter of buttons will require 1 liter of solution, though more is necessary for large or dark-colored buttons than for small or light ones. The oxalic acid solution should be kept ice cold if possible or at least below 20° C. Commercial sodium peroxide is now added in small quantities with constant stirring till the solution is alkaline to litmus paper. About 40 to 45 grams will be required per liter according to the purity of the chemicals. A very little of the 5 per cent oxalic acid solution is now added till, after stirring, the solution reacts acid to litmus. It is important that the solution be acid, but a large excess of acid is to be avoided.

"The buttons are allowed to lie in this solution for 24 to 72 hours according to their size and color. Bleaching proceeds better and more rapidly if the buttons are exposed to direct sunlight while lying in the liquor. This can be done in colorless glass jars which, if possible, should be tightly stoppered.

"The buttons after removal from the bleach liquor may be washed with water containing a little hydrochloric acid. This removes the encrustation from the outside and brings out the luster. After washing again with water they are ready for the further processes of manufacture.

"It will be found that buttons can be bleached effectively by this means and that the strength of the shell is increased by the deposition of calcium oxalate in the interior."

## VI. PRECIOUS CORAL.

A small spray of true precious coral (*Corallium* sp.) was found on the beach of the Gulf of Davao, Mindanao, directly in front of the small station called Vigas. This specimen resembled very closely a species of Japanese precious coral (*C. japonicum* Kishinouye).

As it is not improbable that considerable quantities of precious coral eventually may be discovered in the Islands, it seems worth while to give a short description of this article of commerce, and to describe the methods employed in coral fisheries.

### DESCRIPTION OF PRECIOUS CORAL.

The precious coral of commerce in its natural state closely resembles a small shrub, or the branch of a tree from which the leaves have been removed. Each stem and twig of this coral shrub has a hard central axis, or skeleton. Outside of this and similar to the bark on a plant is the thin soft covering or skin, which is easily rubbed off when fresh and is friable when dry. There are numerous small holes in the "skin" through which minute, flower-like animals project when the coral is alive; these are the coral animals (zoöids); each of them has 8 small arms or tentacles around its mouth, with which it gathers food. All of these zoöids are connected by a vascular system inside of the skin.

The hard part or skeleton is the valuable portion of the coral. It is made up of fused spicules consisting of carbonate of calcium with a small amount of silica and magnesia. The structure is concentric with radiating lines. The entire skeleton is very hard and so compact that no pores can be seen in a cross-section without the aid of a lens. This furnishes an easy test for distinguishing the precious coral from the numerous varieties of no value.

In color these corals range from white or delicate pink to dark red. Precious corals reproduce sexually, and by budding. The reproductive organs are internal and attached to the faces of the mesenteries; they shed their contents within the body where fertilization takes place. The precious corals are believed to be viviparous. Colonies are sometimes composed entirely of males, sometimes entirely of females, frequently all on one branch are males, while all on another branch of the same colony are females. Occasionally both sexes are combined in one animal, forming a hermaphrodite. The eggs contain a considerable amount of yolk and when hatched the larval forms are free swimming and may move a fair distance before they settle and become fixed.

The food of the precious corals consists of living organisms; they have been known to eat the powdered flesh of fishes.

### VARIETIES AND DISTRIBUTION OF PRECIOUS CORALS.

The best known species of precious coral is *Corallium nobilis* Pallas, more generally known under its synonym of *C. rubrum* Linn. This species is found in the Mediterranean Sea off the northern coast of Africa, also off the coast of

Tunis, Sardinia, Italy, Corsica, and at the Cape Verde Islands. Eight species of precious coral have been described from Japan. These are *Corallium japonicum* Kishinouye, *C. elatius* Ridley, *C. boshuensis* Kishinouye, *C. sulcatum* Kishinouye, *C. pusillum* Kishinouye, *C. inutile* Kishinouye, *C. confusum* Moroff, and *C. konojoi* Kishinouye. Two species, *C. johnsoni* (Gray) and *C. maderense* (Johnson), are found in Madeira. *C. stylasteroides* (Ridley) occurs in Mauritius, *C. reginæ* (Hickson) is found in Timor, and *C. secundum* (Dana) has been found at Banda, Ki Islands and in the Hawaiian Islands. This constitutes the entire list of established species of precious corals known to the present time.

The vertical distribution of these corals in the sea varies from 5 to 500 or more fathoms. They are found attached to rocks, dead shells, or dead coral; some species seem to prefer overhanging, submarine cliffs.

In general the vertical distribution of the Japanese species ranges from 50 to 180 meters, while in the Mediterranean fisheries the work of obtaining the coral is usually carried on in waters of much greater depth.

### FISHING FOR PRECIOUS CORAL.

Fishing for precious coral is almost always carried on by means of various sorts of dredges. In Japan the dredge consists of a rectangular bag net about 1.5 meters wide and 1 meter high, with a 13 centimeters mesh, this is fastened to a frame of bamboo, tufts of old netting are fastened to the lower edge of the net and at the sides. These collect many broken coral branches. The coral fishing boats are allowed to drift over the banks with the sails at half mast. The net is allowed to touch the bottom and proceeds with a jerking motion. When the fishermen think they have secured or fastened to coral they pull up the net.

The dredge used in the Mediterranean coral fisheries is of wood in the shape of a large cross with a heavy stone attached to the extremity of the lower arm and with coarse, twine bags of large mesh and with numerous tangles of frayed ropes attached to the anterior arms. Numerous variations of this, as well as ordinary tangles, are also used.

### USES AND VALUE OF PRECIOUS CORAL.

The chief use of precious coral is in the manufacture of coral beads and ornaments. It is first sorted into different grades, of which there are several recognized in commerce; it is then cut into suitable pieces and all necessary holes are drilled in it. It is then filed into any shape desired, and engraved. Next it is polished with pumice stone and water, followed by a polish of very fine chalk and water. Oil is never used on coral.

The value of precious coral depends upon its color, form, and quantity. A string of large uniform beads may be bought in Italy for 20 pesos, while a string of beads of similar size but of the best quality will cost 400 pesos. Japanese precious coral in its native state sells for from 100 to 500 pesos per kilogram, and the best Mediterranean sells for twice these amounts.

The export value of coral from Japan is about 500,000 pesos per year.

### THE CULTURE OF CORAL.

The culture of precious corals has not received the careful scientific attention that it should.

*C. nobils* has been kept alive for some time in aquaria, and if it were planted under natural conditions possibly it could be grown with profit. Careful experimenting along this line might lead to useful and valuable information.

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### BLUE CORAL.

In numerous localities throughout the Philippine Archipelago a fine quantity of blue coral, *Heliopora cœrulea* Linn., is found in considerable quantities, usually in water of from 2 to 10 fathoms depth.

This coral is a beautiful, permanent, cerulean blue in color. It takes a fine polish and is found in large heavy masses. No doubt it could be used in jewelry and ornamental work. No amount of polishing, however, will entirely obliterate the pores. I have collected this coral at Jolo, and at Butuan, Mindanao, on the eastern coast of Samar, and on the northern coast of Palawan. No use is made of it at the present time, but as a body for broaches, bracelets, etc., it would be very beautiful or as a background for pearls it would, in my judgment, be unsurpassed.

### RED ORGAN-PIPE CORAL.

The red organ-pipe coral (*Tubipora* spp.) is very common throughout the Philippines. It has no especial value, its only use apparently being for cabinet specimens. It is a shallow-water form. I have seen large blocks of it used with other corals in the construction of a wharf.

### REEF CORALS.

The common reef corals comprising a great variety of genera and species, which have as yet never been identified, are used largely in the building of roads throughout the Islands. They are employed to a limited extent in the manufacture of lime.

### BLACK CORAL.

The so-called black coral (*Antipatharia* sp.) is very common in the Philippines. Fine specimens several meters in length and from 5 to 15 millimeters in diameter are common throughout the Jolo Archipelago. It is also found in larger quantities in the Gulf of Davao, Mindanao and near Cebu. It is usually secured in water of from 10 to 20 fathoms.

The U. S. S. *Albatross* dredged large quantities of this "insulated cable wire" as it was called by the sailors and this term, indeed, is fairly descriptive of the body of this coral; however, the branches are very numerous and give the small corals a decidedly shrub-like appearance.

[13] This report includes a complete bibliography relating to corals.

This coral is used chiefly for making canes, as it is easily straightened or bent into any desired shape by immersion in hot water for a short time. It takes a most beautiful jet-black polish and could doubtless be used in the manufacture of coral beads and rosaries. A cane of this coral nicely prepared and polished can be bought for from 5 to 10 pesos. The raw material has very little value at present.

## VII. EDIBLE SEAWEEDS OF THE PHILIPPINES.[14]

In connection with the series of articles on minor marine products, it has been thought advisable to include what is known regarding the edible seaweeds, with the hope that the publication of the meager data available may stimulate interest in the subject. Below is given a list of the species known to be used for food, and it is confidently expected that eventually it will be greatly extended as data on the subject become available. Very little seems to have been published on the subject. The determinations have kindly been made by Dr. M. A. Howe, of the New York Botanical Garden. The list is for the most part based on a collection made by Eugenio Fénix of the Bureau of Science, in Union Province, Luzon, supplemented by some local observations in and about Manila.

In most parts of the Philippines, along the seashore, various species of marine algæ or seaweeds are found, although in this Archipelago as in most tropical countries, these are not found in masses, or in such great quantities as is the case with many forms in temperate regions, at least in shallow waters.

The first impression on studying Philippine algæ is that the number of species is very limited, but intensive collecting has brought to light a considerable number and, doubtless, as botanical exploration progresses, the list of Philippine algæ will be greatly increased. In some regions the marine algæ play no small part in the economy of the natives, a considerable number being used for food, thus entering into the local commerce.

At the present time a large percentage of our material is unclassified. Doubtless very many of our species are used for food, but collectors have given this phase of the subject comparatively little attention, so that the data on the utilization of local marine algæ are very fragmentary.

Seaweeds are used for food both raw, in the form of salads, and cooked sometimes with vegetables, such as tomatoes, and sometimes with the addition of sugar, forming the dish, popular among the natives, known to the Tagalogs as *gulaman*. It is probable that in Manila, at least, a large part of the *gulaman* is made from prepared seaweeds imported by the Chinese, although the local product is almost always to be found in the markets. In Manila various species of algæ are known as *gulaman*, but the most important appear to be *Aghardiella* sp. (*Fucus gulaman* Blanco), and *Gracillaria confervoides* (L.) Grev.

[14] Data supplied by E. D. Merrill, botanist, Bureau of Science.

**Aghardhiella** sp. (*Fucus gulaman* Blanco). This species is common in Manila Bay and is universally known to the Tagalogs as *gulaman*. It is probably the most generally used species in Manila, and during certain seasons is almost always to be found in the native markets.

**Chaetomorpha crassa** (Ag.) Kütz. Known in Union Province as *cauat-cauat*, and locally used for food.

**Codium tenue** Kütz. Known in Union Province as *pupu-lo;* edible.

**Enteromorpha intestinalis** L. This green alga is abundant in brackish water about the mouths of streams, and is eaten by the natives to some extent.

**Eucheuma spinosum** (L.) J. Ag. Known in Union Province as *ruprippuuc;* edible.

**Gracillaria confervoides** (L.) Grev. Abundant in Manila Bay at certain seasons, locally known as *gulaman*, and sold in the native markets of Manila.

**Gracillaria crassa** Harv. Used for food in Union Province; known to the Ilocanos as *susueldot-baybay*.

**Gracillaria eucheumoides** Harv. Known in Union Province as *canot-canot;* edible.

**Gracillaria lichenoides** (L.) Grev. Known in Union Province as *guraman;* edible. The above four species are allied to a Japanese species largely used in the manufacture of agar-agar.[15]

**Halymenia formosa** Harv. Known in Union Province as *gamet;* there used for food. An allied species found in Manila Bay, native name unknown, is doubtless also edible.

**Liagora cheyneana** Harv. Known in Union Province as *baris-baris;* edible.

**Sargassum siliquosum** J. Ag. Known in Union Province as *aragan*, there used for food. Widely distributed in the Philippines, as are several other species of the genus, all of which are doubtless utilized to a greater or less extent as food.

## VIII. THE PREPARATION OF ISINGLASS IN THE PHILIPPINES.

The preparation of isinglass is an industry that could be carried on easily in the Philippines, but so far as I have been able to ascertain, it has never been inaugurated.

Isinglass is the purest form of commercial gelatin known; it is prepared from the "sounds" or air-bladders of certain fishes.

The preparation is very simple and requires no outlay of capital. The exact method of procedure is as follows:

Remove the air bladders (also called "maw", "swim bladder") from the fishes soon after they are caught, slit them open and wash thoroughly, take off any thin membranes which envelop them. Then expose to the air to stiffen. If oily, wash in lime water, then in fresh water and dry. They should be put to dry on "flakes" or nets so the air will have free access to all parts. It is sometimes desirable to give slight pressure in which case they may be dried between sheets of paper, or flat driers, like botanical specimens. When thoroughly dry they are put up in convenient packages and are ready for market.

[15] The well known seaweed-isinglass, or *agar-agar* of Japan, is made from an alga of the genus *Gelidium*. This genus has not yet been reported from the Philippines.

### USES OF ISINGLASS.

Probably the chief use of isinglass is in fining liquors of various sorts, especially the best grades of wine. It is also used in the preparation of creams and jellies, in stiffening fabrics, and in lustering ribbons. Isinglass is also used in the manufacture of court plaster, artificial pearls, diamond cement, and imitation glass.

It is true that owing to the expense of securing pure fish isinglass, agar-agar prepared from seaweed, is used largely as a substitute. However, there is no question that pure, fish isinglass is more desirable and gives better results in almost all cases than the vegetable product.

### FISHES FROM WHICH ISINGLASS IS SECURED.

The best grade of isinglass is secured from the sturgeon and is put up in Russia. In the Malay Archipelago a very fair grade of isinglass is secured from the fishes called thread-fin and from certain species of catfish and croakers. In the Philippines, a profitable source of isinglass could be found in the thread-fin, *Polydactylus plebeius* (Brouss.), called *mamali* in Tagalog, and *tatik* in Moro. It is a very common fish in the Manila markets, and ranges in length from 35 to 50 centimeters. The common catfish (*Netuma nasuta* Bl.), called *kanduli* in Tagalog, which is very abundant, especially in Laguna de Bay, also supplies a good grade of isinglass. In addition, there are several species of croakers, (*Otolithes argenteus* Kuhl & Van Hasselt), (*Otolithes leuciscus* Gunth.), and *Johnius belengeri* C. & V.), and at least two species of *Umbrina,* from all of which isinglass can be secured. The above are all common market-fish and *it has been estimated that the isinglass thrown away from them is greater in value than the price secured by the fisherman for the entire fish.*

### VALUE OF ISINGLASS.

The current value of isinglass quoted from a late trade journal is as follows:

Russian isinglass, 2.75 to 3 dollars per pound; American isinglass, 0.73 to 0.75 dollar per pound; 14,000 pounds were imported into New York during the month of April, 1911.

There seems to be no local demand for this product, but, owing to the recent tariff regulation, it would enter the United States duty free; consequently, it could be exported from the Philippines with profit.

## IX. PREPARING SKINS OF AQUATIC ANIMALS FOR LEATHER.

### CAYMAN OR CROCODILE SKIN.

(*Crocodilus porosus* Schneider and *C. palustris* Lesson.)

For commercial purposes, skins of the medium-sized cayman, of about 3 meters (9 feet) length, are the most desirable as they are easier to tan, and make the best leather. The skin should be cut along the middle line of the belly from the chin to the tip of the tail and carefully removed

from the animal soon after its death. Fine salt in sufficient quantity should then be rubbed thoroughly into the raw side of the skin. It is then rolled compactly and placed in a dry place to cure; occasional examination should be made to see if it is curing properly. When thoroughly cured the skin is ready for tanning.

To tan, it is first soaked in a tub of clear fresh water from two to six days—depending on the size of the skin,—a 3-meter skin requires about five days. It is then placed in a rather weak solution of lime and water which should be increased in strength daily for about ten days. The wet skin is now placed on a smooth beam, raw side out, and all the fat or flesh rubbed or shaved off. It is then placed in a thick mixture of bran and water and allowed to soak for one day—this is to neutralize the alkali of the lime. During all of the above processes through the solutions it is better if the skin be agitated occasionally so that all parts receive sufficient treatment. The hide is then washed and immersed in a tank of tanning extract. Any of the native tans may be used, or oak bark, gambia, or sumac liquid of 4 per cent strength, and stronger liquid is added each day until the strength has reached 20 per cent at the end of eighteen days. The length of time will vary according to the size of the skin, strength of the solution, or the color desired. The hide is then hung up to dry and harden. It is then shaved and cleaned again so as to leave it of the desired thickness. If black, red, brown, or green shades of color are desired the skin is put into a bath of wood and aniline dyes, for about three-quarters of an hour. It is then stretched out and nailed to a board or wide frame for drying. When dry it is rubbed briskly over an iron or wooden beam to make it flexible.[16] The skin is then ready for use. The price paid for prepared skins is from 2 to 4 pesos per 20 lineal centimeters.

So far as I have been able to learn no serious attempt has been made to prepare the Philippine crocodile skin for leather. It is an experiment well worth trying, as the cayman is notoriously abundant in many streams of the Philippines.

### WATER-SNAKE SKINS.

(*Lapemis hardwickii* Gray, *Chersydrus granulatus* Schneider, and other species.)

There are great numbers of water snakes in the Philippines. I have seen more than one hundred brought in with one haul of an ordinary fish sein on the Malate beach. It is quite probable that a good industry could be built up in tanning the skins of these snakes for leather. Many of them are finely marked and would make attractive belts, card cases, and ornamental objects. Considerable quantities of snake-skin leather are used in France. The following is the method of preparation:

The skins are removed from the animals and soaked for ten days in a strong solution of sulphate of zinc. They are then fleshed, scraped, washed by hand, and placed in a bath containing 100 parts water, 10 parts borax, 100 parts boracic acid, 25 parts tartaric acid, and 25 parts saturated solution of precipitated alumina. They remain in this bath one day and are then transferred to bath No. 2 containing 1000 parts water, 25 parts phosphate of zinc, 25 parts benzoate of aluminium, 50 parts glycerine, 20 parts alcohol. The skins are

[16] *Report U. S. Fish Comm.* (1902), 350.

left one day in this solution, then they are placed in the first bath again for one day, then back into the second for another day, this alternating of baths being continued for five or six days, by which time the tanning is complete. The skins are then dried, lightly staked, and finished off.

### PREPARING SHARK SKIN.

Shark skin is used for a great many purposes, especially for sword grips, knife and sword sheaths, for polishing wood and ivory, and for covering small ornamental objects, such as jewel boxes or card cases. A manufacturer in Paris has made a big reputation by tanning the skin of the Malabar shark into morocco leather.

Some very beautifully marked sharks are found in the Philippines such as *Chiloscyllium indicum* (Gm.), *Stegostoma tigrinum* Linn., *Seyllium capense* Mull. & Hen., and *S. marmoratum* Gray & Hard. Their skins could be made into excellent leather.

To tan shark skins, the skins are (if hard) first soaked in water for four or five days; they then are placed in a solution of lime and water, as in the case of the crocodile skins; they remain in this solution from two to six days, and are then washed free of lime, and soaked in bran water for a day or so; they are then fleshed, or shaved, and immersed in an alum solution composed of 0.5 kilogram of alum and 0.1 kilogram of salt to 4 liters of water; they remain in this solution two or three days, with occasional stirrings. On removal they are dried and are ready for manufacturing.

To prepare shark's skin for the use of cabinet-makers it is merely cleaned and not tanned, the hard dry skin is soaked in lukewarm water for three or four days, shaved on the flesh side, and then dried. This skin will outwear many sheets of sand-paper of equal size.

We are indebted to Chas. H. Stevenson's valuable paper regarding methods of tanning, for much of the above information.[17]

## X. A CHECK LIST OF PHILIPPINE HOLOTHURIANS.

1. **Cucumaria conjungens** Semper.

General color brownish. Habitat: Mariveles, Luzon. In shallow water. Length 20–25 millimeters.

2. **Cucumaria longipeda** Semper.

Color dull gray. Habitat: Bohol, Pandanon. In water of 30 fathoms. Length 20 millimeters.

3. **Cucumaria citrea** Semper.

Color orange-yellow. Habitat: Bohol. In 8 fathoms. Length 15–20 millimeters.

4. **Cucumaria versicolor** Semper.

General color olive-green. Habitat: Bohol. In water of 6 to 10 fathoms. Length 6–7 centimeters.

5. **Cucumaria maculata** Semper.

Habitat: Bohol. In water of 10 fathoms. Length 4.5 centimeters.

[17] *Report U. S. Fish Comm.* (1902), 283.

6. **Cucumaria mirabilis** Théel.
Habitat: Cebu, at the depth of 100 fathoms.

7. **Cucumaria canescens** Semper.
Habitat: Bohol. In water from 6 to 30 fathoms. Length 1.5–3 centimeters.

8. **Mülleria nobilis** Sel.
General color dusky. Habitat: Bohol. In shallow water.

9. **Mülleria mauritiana** Quoy & Gaim.
Habitat: Philippines. In shallow water.

10. **Mülleria lecanora** Jæger.
General color dirty yellowish. Habitat: Philippines. In shallow water up to 6 fathoms.

11. **Psolus complanatus** Semper.
General color grayish. Habitat: Zamboanga. In shallow water. Length 22 millimeters.

12. **Psolus boholensis** Semper.
Upper portion gray, lighter below. Habitat: Bohol. In water from 6 to 17 fathoms. Length 15 millimeters.

13. **Psolus boholensis pandanensis** Semper.
Habitat: Bohol at Pandanon. In water of 30 fathoms.

14. **Thyone villosa** Semper.
General color yellowish-brown. Habitat: Philippines. In water of 10 fathoms. Length 20–30 millimeters

15. **Thyone rigida** Semper.
General color grayish brown. Habitat: Bohol. In 10 fathoms.

16. **Thyonidium cebuense** Semper.
General color brownish gray. Habitat: Cebú. In 10 fathoms. Length 30–35 millimeters.

17. **Echinocucumis adversaria** Semper.
General color grayish. Habitat: Bohol. In 30 fathoms. Length 8–10 millimeters.

18. **Haplodactyla molpadioides** Semper.
General color pale-violet or lavender. Five branching papillæ around the anal pore. Habitat: Bohol, Cebú. In 13 to 20 fathoms.

19. **Haplodactyla molpadioides pellucida** Selenka.
Habitat: Cebú. Shallow water.

20. **Chirodota rigida** Semper.
Color light brown with whitish dots. Habitat: Bohol.

21. **Chirodota incongrua** Semper.
Sixteen tentacles, each with 18 to 20 digits. Habitat: Camiguin Island. Shallow water.

22. **Chirodota dubia** Semper.
Tentacles 18, each with 18 to 20 digits. Habitat: Camiguin Island. Shallow water.

23. **Chirodota variabilis** Semper.
Tentacles 17 or 18, each with 20 to 24 digits. Habitat: Mariveles, Luzon.

24. **Chirodota panaensis** Semper.
Habitat: Panay. Shallow water.

25. **Synapta dubia** Semper.
Habitat: Bohol. In water from 6 to 10 fathoms.

26. **Synapta pseudo-digitata** Semper.
Habitat: Bohol. In water of 15 fathoms.

27. **Synapta molesta** Semper.
Habitat: Philippines. In shallow water.

28. **Synapta reticulata** Semper.
Habitat: Philippines. In water of 8 fathoms.

29. **Synapta indivisa** Semper.
Tentacles 13, each with about 20 very long slender digits. Habitat: Zamboanga.

30. **Synapta nigra** Semper.
Digits of tentacles united by web at base. Habitat: Bohol. In shallow water.

31. **Synapta grisea** Semper.
Color in life greenish-gray, arranged in spots and bands, the ground color being a dirty light-green. Habitat: Bohol. In water from 4 to 6 fathoms.

32. **Synapta glabra** Semper.
Color dark yellowish-brown above, yellowish below. Habitat: Cebú, Bohol. Length 500 millimeters. Found in water from 4 to 6 fathoms.

33. **Synapta innominata** Ludwig.
Habitat: Manila Bay.

34. **Synapta recta** Semper.
Thirteen tentacles, with very short digits. Habitat: Bohol. In water of 6 to 8 fathoms.

35. **Synapta gracilis** Semper.
General color whitish with slight wash of yellowish-brown. Habitat: Manila Bay.

36. **Synapta beselii** Jæger.
Color in life greenish. Habitat: Cebú reefs.

37. **Synapta similis** Semper.
Pinkish-white, with some brown anteriorly. Habitat: Bohol. In shallow water.

38. **Ocnus pygmæus** Semper.
Upper color greenish, the underparts yellowish-brown. Habitat: Bohol. In water of 9 fathoms. Length 10 millimeters.

39. **Ocnus imbricatus** Semper.
General color yellowish-brown, lighter below. Habitat: Bohol. In water of 8 to 15 fathoms. Length 35–40 millimeters.

40. **Colochirus cœruleus** Semper.
General color pinkish and green with markings of yellowish. Habitat: Bohol. In water of 10 fathoms. Length 18–20 centimeters.

41. **Colochirus viridis** Semper.
General color sea-green. Habitat: Zamboanga, Mindanao. In shallow water.

42. **Colochirus cucumis** Semper.
Habitat: Bohol. In 6 fathoms. Length 3 centimeters.

43. **Colochirus anceps** Selenka.

General color orange, the feet red. Habitat: Bohol. Shallow water up to 10 fathoms. Length 8–10 centimeters.

44. **Colochirus cylindricus** Semper.

Habitat: Bohol. In water of 10 fathoms. Length 5 centimeters.

45. **Colochirus tuberculosus** Quoy & Gaim.

Habitat: Bohol. In shallow water and up to 10 fathoms.

46. **Colochirus quadrangularis** Less.

Habitat: Bohol. In shallow water and up to 10 fathoms.

47. **Stichopus variegatus** Semper.

Yellowish-gray with markings of gray and brown. Habitat: Philippines. In shallow water up to 10 fathoms.

48. **Stichopus naso** Semper.

General color yellowish-gray. Habitat: Bohol. In 10 to 15 fathoms.

49. **Holothuria marmorata** Jæger.

Auburn above, with some large spots or bands of yellowish-white; yellowish below. Scattered over the sides of the body are violet spots on a yellowish-white area. The deposits in the body wall are X-shaped, or oval with central incisions on each side. Habitat: Bohol. In shallow water.

50. **Holothuria tenuissima** Semper.

Pedicels all over the body. The deposits consist of incomplete rosettes, or slightly branched rods. Habitat: Bohol, in 15 fathoms of water.

51. **Holothuria similis** Semper.

Fine papillæ all over the body. Habitat: Bohol, in 10 to 15 fathoms of water.

52. **Holothuria erinæus** Semper.

Color dark-brown or blackish, lighter below; pedicels a light yellowish-brown. The rods bear a few spines on their sides, their ends are slightly branched or perforated. Habitat: Bohol and Luzon, in shallow water.

53. **Holothuria gräffei** Semper.

Ventral pedicels in three distinct longitudinal series. The dorsal papillæ large. The deposits consist of tables, rosettes, and irregular branched plates. Habitat: Luzon.

54. **Holothuria pulchella** Selenka.

The ventral pedicels are more crowded than the dorsal papillæ. The spire of the table consisting of a reduced almost annular disk, with 12 teeth on the top. Habitat: Philippine Islands, in shallow water.

55. **Holothuria pervicax** Selenka.

Color in alcohol grayish-brown, with some darker cross bands on the back. The pedicels and papillæ are about the same size. The ventral surface is more crowded. The tables are not well developed, the spire being short and terminating in but 4 teeth; disks small, rounded, smooth or slightly uneven on the margins. Rods small, elongate, and uneven on the margins, or with holes on the sides. Habitat: Philippine Islands.

56. **Holothuria atra** Jæger.

Dorsal papillæ and ventral pedicels of nearly equal size. Disks forming simple rings; often with small hole at the base of each vertical rod. The spire terminating in 8 horizontal and 4 vertical teeth. The plates are evenly rounded, or

undulated on margins, often with X-shaped branches. Habitat: Philippine Islands, in shallow water.

57. **Holothuria edulis** Lesson.

Color a dark reddish-brown, light gray on sides and belly, a minute, dark ring around the base of the pedicels. The dorsal papillæ are very minute and more scattered than the ventral pedicels. Disk of the tables reduced to a small ring more narrow than the top of the spire, which, when seen from above, presents a small circular hole surrounded by 4 prominences, each with 4 or 5 teeth. Habitat: Bohol, in 10 to 20 fathoms of water.

58. **Holothuria monacaria** Lesson.

Color yellowish white, speckled with brown or greenish-brown on the back. The young specimens are auburn, with the ventral surface white. The papillæ paler. The dorsal papillæ are arranged in 4 indistinct longitudinal rows. The rounded disks of the tables have a central hole surrounded by 4 to 12 holes. The spire terminates in 12 teeth. Habitat: Zamboanga, in shallow water. Length 110 millimeters.

59. **Holothuria vagabunda** Selenka.

The color varies from a dark brown to a reddish-brown. The tables have small disks; the spires terminate in 8 to 10 teeth placed around a nearly circular aperture at their top; buttons with 6 holes; the dorsal pedicels alone have supporting rods, these are spinous and taper towards the ends [illegible] pines, in shallow water.

60. **Holothuria fusco-cinerea** Jæger.

Color dusky-red, with some darker transverse bands on the back. The table never seem to attain the usual length of the spire, nor to have the usual number of transverse beams. Habitat: Bohol, in 6 to 10 fathoms of water. Length 222 millimeters.

61. **Holothuria immobilis** Semper.

Color on dorsal surface brown, with some darker spots or bands, belly dirty yellowish-white inclined to brown anteriorly. Tentacles 26; ventral surface with pedicels, the dorsal surface with papillæ. The disks of the tables spinous; the buttons irregularly formed, with about six holes. Habitat: Bohol, in from 6 to 8 fathoms of water.

62. **Holothuria coluber** Semper.

The dorsal surface with papillae; ventral surface with pedicels. The tables have long spire of 4 rods, and 3 to 5 transverse beams. Habitat: Bohol, in 6 to 8 fathoms.

63. **Holothuria impatiens** Forskål.

Color in alcohol, light brown, inclined to violet. Integuments rough, the smooth disks of the tables are pierced with 9 holes of equal size; buttons symmetrical with 6 holes. Habitat: Philippines, in 6 fathoms.

64. **Holothuria scabra** Jæger.

The color varies with different localities. Some are cinereous with almost black transverse bands, with a few small whitish bands or spots on the back, the belly being yellowish-white, and each papilla being surrounded with a small dark circle. In other localities they are paler and punctated with a few large dark spots, but are without the dark bands. The tables are solid, with smooth, well developed disks, spires of usual shape with 12 to 16 teeth. The buttons have 6 holes, are symmetrical, and for the most part knotted. Habitat: Bohol, in shallow water. Length 170 millimeters.

65. **Holothuria albiventer** Semper.

Belly dirty gray, finely punctated; papillæ whitish; back dusky; tentacles yellowish-white. The tables have large rounded disk with numerous small holes. The spire is formed by 6 or 10 rods, its large rounded top is covered with small teeth; buttons oval. Habitat: Bohol, in shallow water.

66. **Holothuria squamifera** Semper.

Papillæ scale-like. Tables small, numerous; spire long narrow, with 5 transverse beams; buttons with from 6 to 12 holes. Habitat: Philippines.

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# ILLUSTRATIONS.

PLATE I. PHILIPPINE TREPANG.

FIG. 1. The oe.
2. The gan sim.
3. The bark sim.
4. The moi whar che.
5. The hong che.

PLATE II. DIFFERENT VARIETIES OF "BARK SIM."

(Third grade Philippine Trepang.)

FIG. 1. Small black trepang.
2. White ringed trepang.
3. Yellowish brown trepang.
4. Dark brown trepang.
5. Convoluted trepang.
6. Small convoluted trepang.

PLATE III. PHILIPPINE SHARK-FIN.

FIG. 1. Dried shark-fin prepared for export.
2. The fin prepared for soup.

PLATE IV. THREE VARIETIES OF SEA TURTLES.

FIG. 1. The loggerhead (*Thalassochelys caretta* Linn.).
2. Head of the loggerhead turtle.
3. The hawksbill turtle (*Chelone imbricata* Linn.).
4. Head of hawksbill turtle.
5. The green turtle (*Chelone mydas* Linn.).
6. Head of green turtle.

PLATE V. PHILIPPINE TORTOISE-SHELL.

FIG. 1. Plate from the hawksbill turtle.
2. Section showing thickness of the above plate.
3. Plate from the green turtle.
4. Section showing thickness of the green turtle shell.

PLATE VI. COMBS MADE IN MANILA FROM PHILIPPINE TORTOISE-SHELL.

PLATE VII. PHILIPPINE WINDOW-SHELL.

FIG. 1. Cross-section of shell near the adductor muscle showing actual width of shell including the animal.
2. Window shell, with growth of crustacean eggs near one margin.
3. Window shell opened and with the mantle of left side removed showing the organs in place.

PLATE VIII. ANATOMY OF THE WINDOW-SHELL MOLLUSK. *a*, Mantle; *b*, pallial fringe; *c*, gills; *d*, adductor muscle; *e*, liver; *f*, genital lobe; *g*, foot; *h*, anal funnel; *i*, labial palps; *j*, ventricle; *k*, auricle; *l*, kidneys.

### Plate IX. Utilizing Window Shell.

Fig. 1. Shell window in the new General Hospital, Manila.
2. Screen made of window shell and red *narra* wood.

### Plate X. Shell Lamps.

Fig. 1. Small porch-light made from window shell.
2. Lantern light made from window shell.
3. Reading lamp made of wood and window shell.
4. The nautilus reading light. *a*, Base of red cement; *b*, stem of red coralline; *c*, shade of chambered nautilus; *d*, electric wire to bulb which is hidden in nautilus shell.

### Plate XI. The Top Shell.

Fig. 1. Top shell (*Trochus niloticus* Linn.). Showing cuts for buttons in the partition walls.
2. Side view of *Trochus niloticus* Linn.
3. *Trochus niloticus* cut through the vertical plane.
4. Top view of *Trochus niloticus* Linn.

### Plate XII. The Turbon Shell.

Fig. 1. Turbon shell (*Turbo marmoratus* Linn.)
2. Turbon shell (young).
3. Turbon shell cut on a vertical plane.
4. Side view of *Turbo marmoratus* Linn.

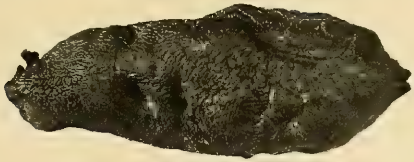


Fig. 1.

Fig. 2.

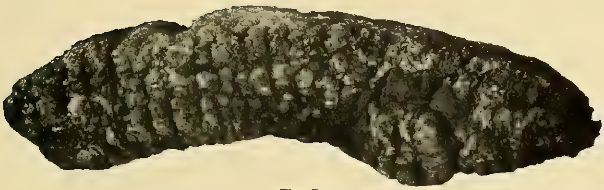


Fig. 3.

Fig. 4.

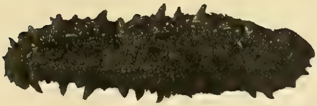


Fig. 5.

PLATE I.

Fig. 1.

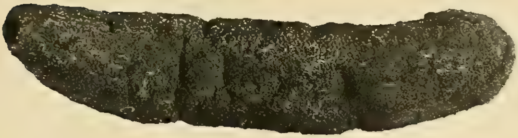


Fig. 2.

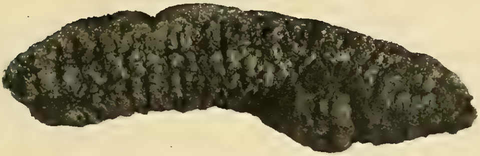
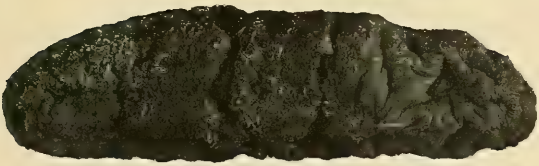


Fig. 3.



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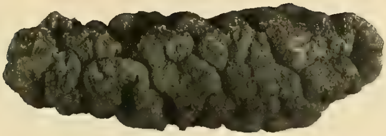


Fig. 5.

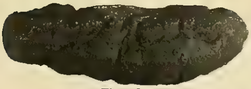


Fig. 6.

PLATE II.

Fig. 1.

Fig. 2.

PLATE III.

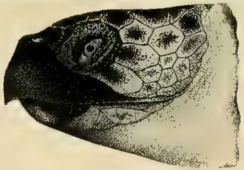
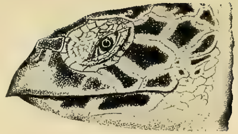


Fig. 2.



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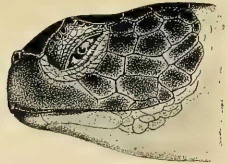


Fig. 6.

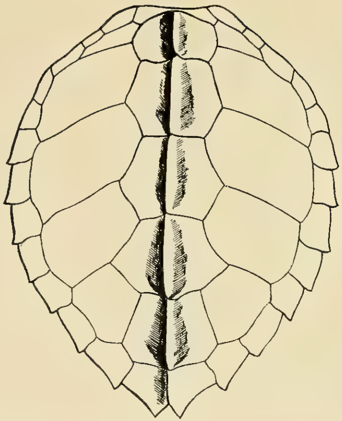


Fig. 1.

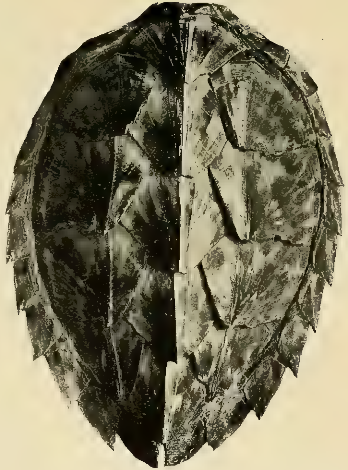


Fig. 3.

Fig. 5.

PLATE IV.

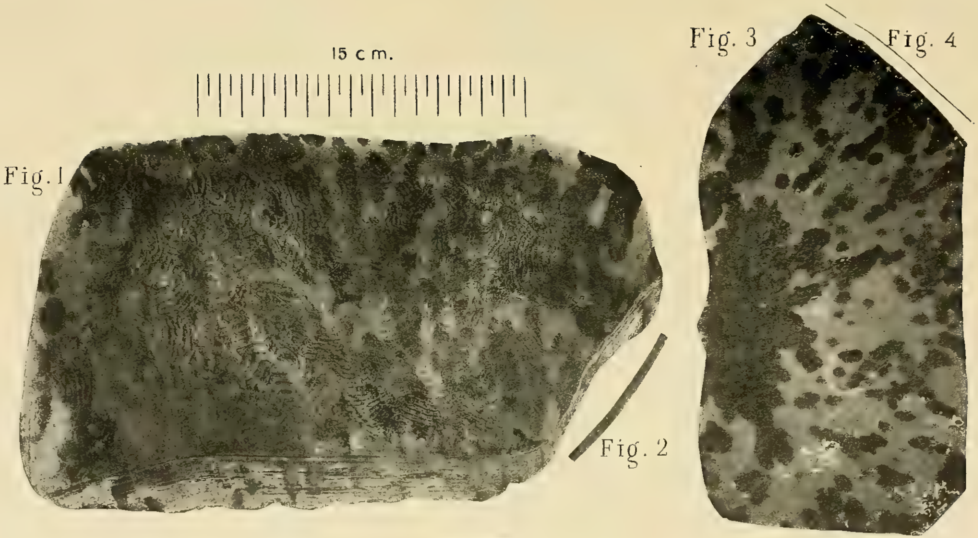



PLATE V.

Fig. 1.

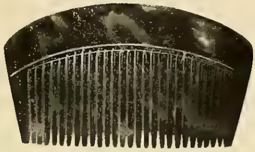
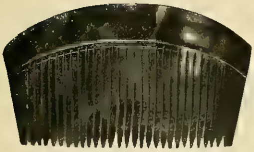


Fig. 4.



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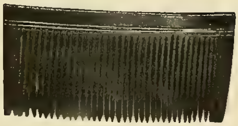

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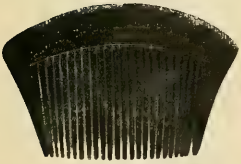

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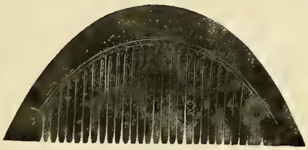


Fig. 6.

15 cm.

PLATE VI.

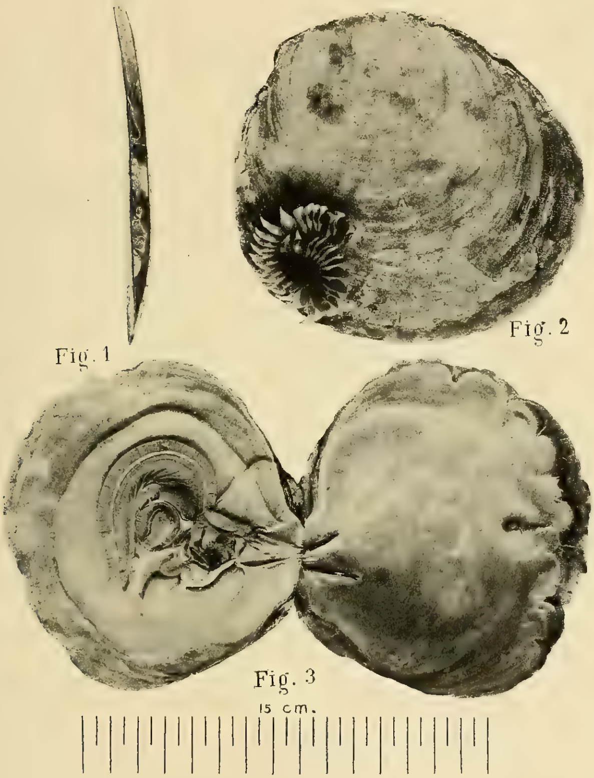



PLATE VII.

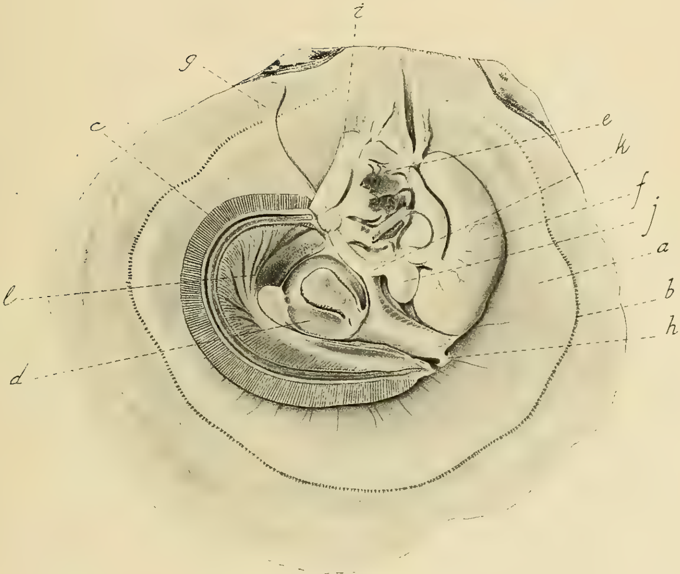



PLATE VIII.

Fig. 1.

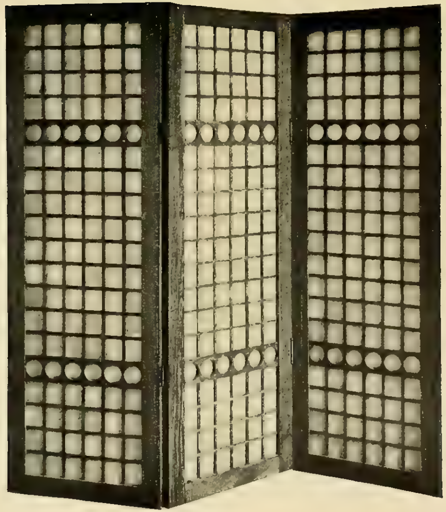


Fig. 2.

PLATE IX.

Fig. 1

Fig. 2

Fig. 3


Fig. 4.

PLATE X.

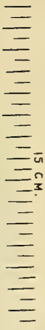
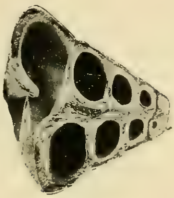



Fig. 1.

Fig 2.



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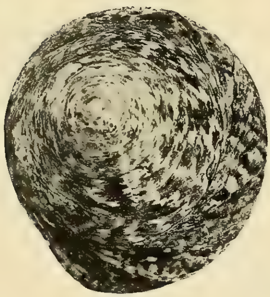

Fig. 4.

PLATE XI.

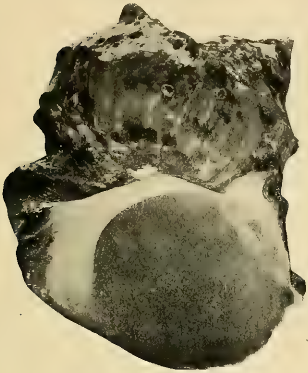

Fig. 1.

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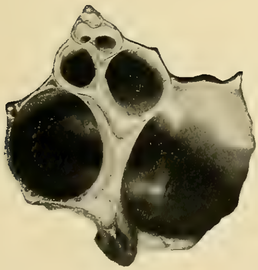

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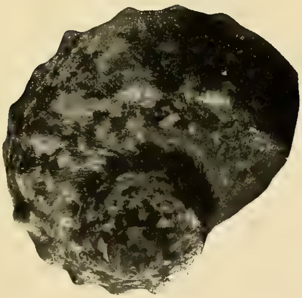

Fig. 4.

15 CM.

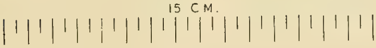

PLATE XII.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

PLATE I.

Fig. 1.

Fig. 2.

Fig. 3.

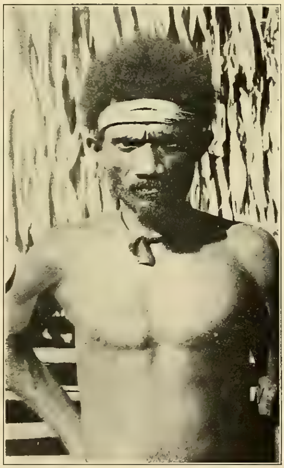

Fig. 4.

PLATE II.

Fig. 1.

Fig. 2.

PLATE III.

PLATE IV.

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D. General Biology, Ethnology and Anthropology.
Vol. VI, No. 6, December, 1911.

# THE NON-CHRISTIAN PEOPLE OF AMBOS CAMARINES.

By MERTON L. MILLER.

(*From the Division of Ethnology, Bureau of Science, Manila, P. I.*)

The Province of Ambos Camarines is occupied mainly by the Bikol people. In the northern part of Camarines Norte there are certain towns which are occupied wholly or in part by Tagalogs. Many of the latter are said to have come in from the north at the time of the discovery of gold at Paracale and neighboring towns. With these exceptions all the municipalities of the province are occupied by Bikols. However in the hills of both Camarines Sur and Camarines Norte there are other people who apparently are neither Tagalog nor Bikol. In Camarines Sur these people know themselves and are known to the Christian population of the towns as "Agta." The great body of them lives on the slopes of the two extinct volcanoes, Iriga and Isarog. They state that in Spanish times white people never ventured among them. Their hostility toward the Spaniards is said to have been due to continual attacks made on them by the latter and to the consequent desire for revenge awakened in the hill people. To all appearances there is no danger whatever in going alone among them at the present time.

Those about Mount Isarog are found for the most part about one-third of the way up the slopes and apparently in about the place where they have lived for years. They formerly were scattered about in the hills, but now are slowly coming to live in groups, although they say they prefer to live scattered about. This is probably partly because they are thus enabled to be nearer to their growing crops and partly because they have been accustomed to this method of life for many years.

The people of Consosep are typical of these groups of Isarog people. Consosep is some six or seven hours travel from Mabatobato, almost all of it uphill. Mabatobato is a *barrio* distant about three and one-half hours from Pili. A schoolhouse is located at Consosep on a spur which juts out from Isarog and is perhaps 610 meters high. The building can be seen for many miles, as the country immediately around it is not wooded. A few hundred yards back of the schoolhouse toward

the mountain are two houses. About the same distance below at a place where the hill is a little less steep is a group of six small houses. Off on another spur, across a deep gulch twenty minutes walk away, can be seen another house. Still others are scattered about in the forest, some near and some several hours' travel away.

The day I was at Consosep about 75 individuals—men, women, and children—came together in response to a call and they were probably not more than one-half or two-thirds of all the people belonging to this settlement. They are a peculiar people. They are not Negritos, although the name by which they are known both among themselves and to others—*Agta*—might indicate that they are. Neither are they typically Malayan. There are, it is true, many among them who do not differ at all in appearance from the ordinary Christian Filipino, but as a rule they are smaller than the average among the latter. They are also darker. Very few of them have straight hair. Some have hair which is almost kinky, while the majority have wavy hair. Some have thick lips and a few the large, noticeable eyes of the typical Negro. (Plate I, figs. 1 and 2; Plate III.)

They dress like most of the other people of the Philippines. The women wear a *camisa* and for a skirt several pieces of cloth wrapped about the body and tucked in at the waist. The men wear trousers reaching to the knees and most of them some kind of a jacket or shirt. However, when working in the fields they wear usually only the loin cloth.

In former times these people lived in rude shelters much like those in which the Negritos still live. Now they dwell in small houses, so small that even they can not stand upright anywhere in them. They are built about 1.5 meters above the ground with floors of bamboo and roofs of leaves.

These people plant upland rice, camotes, maize, taro, squash, bananas, yams, and some few other plants. They have no goats or sheep, but occasionally kill birds to eat.

An old woman with whom I talked who had lived at Consosep all her life said that she did not remember a time when there were Negritos about there. From this as well as from the appearance of the people one would conclude that the Negrito admixture took place many years ago. She also said that formerly they were more numerous than now, that they had been killed by smallpox, cholera, and in fights with the Spaniards, but that they were increasing in number now.

They marry at from 13 to 15 years of age. The old woman above mentioned told me of one woman who had eight children. One man sometimes has as many as three wives, although as a rule they are monogamous. They are said to have a language of their own which has

some Bikol words in it. It may be, however, that this is merely a dialectic variation of Bikol and not a distinct language.

On the Kalawat Islands, which lie a few miles east of Paracale in Camarines Norte, there is a small population most of whom are Bikol, like the people on the mainland opposite, but there are besides the Bikols certain small groups of people known as "Dumagat." They live for the most part in small groups by themselves not far from the Bikol settlements. These people too, like the Agta of Camarines Sur, show evidence of Negrito blood. They are darker than their Bikol neighbors though not noticeably smaller. Some of them have wavy and some curly hair while others have hair as straight as the ordinary Filipino. (Plate I, figs. 3 and 4.)

The Dumagat people of Kaboong Island, one of the Kalawat group, said they came from the mainland. One man was from near Nueva Caceres and looked much like the people about Mount Isarog. They said that they had all been baptized, but the probability is that they are practically non-Christians, as they are remote from any Christian influence. They talk Bikol among themselves, live for the most part scattered about on the hillsides in houses like those of other Filipinos, plant camotes, maize, taro, and yams, but do not plant rice. They had never heard of Negritos living on the Kalawat Islands. They say they call themselves Dumagat because they live near the sea.

I was told that on Butawanan Island off Kinabugsukan Point in Camarines Sur there is a considerable number of these Dumagat people. There are also a few of them scattered among the Bikol people of the coast towns. I did not visit Butawanan and so can not say whether the people of that island resemble the Dumagat of the Kalawat Islands.

There are three possible explanations of the origin both of the Agta people in the vicinity of Mounts Isarog and Iriga, and of the Dumagat of the Islands off the east coast of the province and of the neighboring shores of the mainland. The resemblance between the two groups is sufficiently close to lead one to believe that their origin may be the same.

The first possibility is that they are remnants of an earlier Malayan invasion which preceded that which brought the Bikols and Tagalogs to the Philippines. The second is that they are the result of crossing between an aboriginal Negrito population and their Malayan neighbors. It is furthermore possible that they may be the result of the crossing of some primitive Malayans with Negritos. That there is Negrito blood in them I have no doubt, although this opinion is based only on their physical appearance.

The simplest explanation of the characteristics of these people is that they are the result of crossing many years ago between the Malayan people and Negritos. Occasionally even now men from the low-

lands join these hill people, preferring the life of the latter to that of their fellows in the plains.

The Negritos in Camarines are to be found both in Camarines Sur and Camarines Norte. In Camarines Sur a few Negritos live near Payatan on the slope of Mount Isarog. Here scattered about they dwell in rude shelters in the forests. They work for their Filipino neighbors. They are typical Negritos, apparently without admixture of other blood.

Near the town of Iriga there is a settlement of about 68 people of mixed Negrito and Malayan blood. Some have almost kinky hair and others hair almost straight. I saw no one at this settlement who appeared to be of pure Negrito blood, although in Iriga itself are some 10 or 15 Negritos who are said to be practically slaves and who are not allowed to leave their masters. They do, however, occasionally escape.

In Camarines Norte on the other hand are many pure Negritos, although how many I am unable to say. There is one group near the *barrio* of Batobelani and there is at least one other group near Ragay on the west coast of Camarines. These Negritos do a little farming on their own account, but they more often work for the Christian Filipinos planting and harvesting crops. When they come into the Christian settlements the women and some of the men wear the ordinary Filipino costume. Others of the men wear only the customary loin cloth. The shelters in which they live are often the simplest possible, consisting of a rough floor and a roof of leaves. (Plates II, IV, V.)

It seems to be a rare thing with them to intermarry with the Christian Filipino. All whom I saw in Camarines Norte looked like pure Negritos with no admixture of other blood. In all probability prejudice against marriage with the Negritos has increased with the coming of Christianity. If this be true most of the blending of the Negrito and Filipino blood which has occurred here took place many years ago.

There are probably several hundred Negritos in Camarines Norte. I suspect most of them have come to be dependent to some extent on the Christian Filipinos and, therefore, live near them. They are a mild-mannered, inoffensive people, but I did not see enough of them to learn much about their mode of life.

They are typical Negritos. They are short of stature, have dark skin, closely curled hair, and flat noses. When they are of pure blood there is never any possibility in the Philippines of mistaking them for any other people.

With the exception of the Negritos, the Dumagat people, and those living about Mounts Isarog and Iriga all the other inhabitants of Camarines I believe to be Bikol, with some Tagalogs in the north and a few individuals from other parts of the Philippines scattered about here and there.

# ILLUSTRATIONS.

PLATE I.

FIG. 1. Woman of Consosep, Camarines, showing no evidence of Negrito blood.
2. Man of Consosep, Camarines, showing strong evidence of Negrito blood.
3 and 4. Men of Kalawat Islands, Camarines, showing traces of Negrito blood.

PLATE II.

FIGS. 1 and 2. Negrito women, near Ragay, Camarines.
FIG. 3. Negrito man, near Ragay, Camarines.
4. Negrito man, near Batobelani, Camarines.

PLATE III.

FIG. 1. Group of men, near Mount Iriga, Camarines. Some evidently have Negrito blood; others not.
2. Negrito hut near Mount Isarog, Camarines.

PLATE IV.

Group of Negrito men, women, and children; Ragay, Camarines.

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# THE STRUCTURE OF THE PALLIAL TENTACLES OF LIMA SPECIES.

By LAWRENCE E. GRIFFIN.[1]

(*From the Zoölogical Laboratory, University of the Philippines.*)

While turning over stones on a coral reef on the eastern coast of Negros, P. I., there came from under one which I lifted a small *Lima* which went flapping off, like a startled *Pecten*, in a desperate effort to escape. From the edges of the mantle trailed scores of delicate tentacles, from 25 to 60 millimeters in length, of a blood-red color. As quickly as possible I caught the little creature and immediately several dozen of the tentacles fastened to my hand. Many of them clung so tightly that they were broken before letting go.

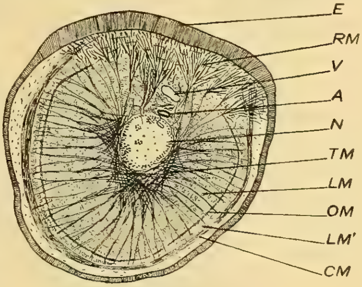


FIG. 1.

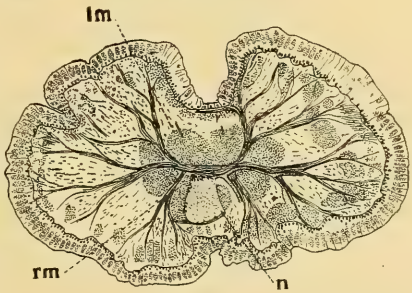


FIG. 2.

Each of the tentacles was ringed with annual grooves. These annulations and the great adhesive power of the tentacles, which seemed to be due more to suction than to a mucilaginous secretion, were immediate reminders of the tentacular cirri of *Nautilus*. This first specimen of *Lima* sp. was destroyed by an accident and it was several months before more were found. These were discovered buried at a depth

[1] Associate professor of zoölogy, University of the Philippines, Manila, P. I.

of 8 to 10 centimeters in the loose broken coral on the inner side of a reef.

A microscopic examination proved that the internal structure of the tentacles of this bivalve is even more remarkably like that of the *Nautilus* cirri than the external structure. A cross section (fig. 1) shows a large nerve extending through the center of the tentacle; radial muscles pass from the central region to all parts of the periphery; and strong longitudinal muscles lie in the spaces between the radial fasciculi. The central portion of the nerve is composed exclusively of fibers. Upon its surface is an almost continuous layer of nerve cells, but more or less distinct aggregations of nerve cells are found at points corresponding to the annular ridges of the surface of the tentacle.

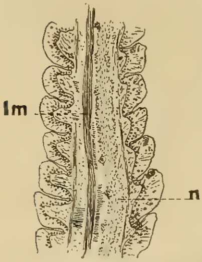


Fig. 3.

As in the *Nautilus* cirri, the epidermal cells are high upon the ridges but very low in the grooves of the tentacle (fig. 3). On the outer surface of the tentacle is a narrow longitudinal groove, at the base of which also the epidermal cells are very low (fig. 1). In some cases the epidermal cells were found to be crowded with mucous secretion.

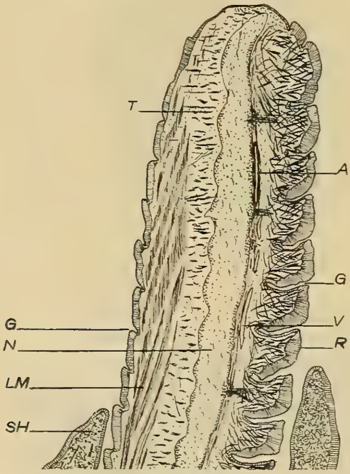


Fig. 4

The muscular development of the *Nautilus* cirri is greater, and there is more difference in the epidermis of the inner and outer surfaces than appears in the tentacles of *Lima*, but in the characteristic structures of the tentacles the differences are those of degree rather than of kind. The striking parallelism of development of these rather complex structures in forms so widely separated systematically, is the more interesting when we remember that the tentacles of *Lima* are appendages of the mantle edge, while those of *Nautilus* belong to the head or foot.

# ILLUSTRATIONS.

TEXT FIGURES.

FIG. 1. Transverse section of a tentacle of *Lima* sp. *lm*, longitudinal muscle bundles; *n*, nerve; *rm*, radial muscles. Original.

2. Transverse section of a cerus of *Nautilus pompilius*. *A*, artery; *CM*, circular muscle layer; *E*, thickened epithelium on inner surface; *LM*, *LM'*, longitudinal muscles; *N*, nerve; *OM*, oblique muscle layer; *RM*, radial muscles; *TM*, transverse or radial muscles; *V*, vein. (From Griffin, Anatomy of Nautilus pompilius.)

3. Longitudinal section of a pallial tentacle of *Lima* sp. Original.

4. Longitudinal section of the tip of a cirrus of *Nautilus pompilius*. (From Griffin, Anatomy of Nautilus pompilius.)

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# BEITRAG ZUR COLEOPTEREN FAUNA DER PHILIPPINEN.

Von J. Moser.
(*Berlin, Germany.*)

**Holotrichia latecostata** sp. nov.

Supra picea, pruinosa, subtus brunnea, nitida, pygidio abdomineque flavis. Capite fortiter subrugoso-punctato clypeo margine antico emarginato; prothorace lato, lateribus medio rotundato-dilatatis, disco sparsim, versus margines laterales paulo densius punctato, linea media laevi, antice abbreviata; scutello remote punctato, medio laevi; elytris, singulo 4-costato, costa prima postice ad suturam versus valde dilatata, subrugoso-punctatis, feminae juxta suturam transversim-plicatis; pygidio haud dense umbilicato-punctato. Subtus medio subtiliter parce punctato, lateribus densius punctatis et flavo-pilosis; tibiis anticis tridentatis, articulo primo tarsorum posticorum secundo aequali.

Long. 16 mill.

Typus No. 11739 in Coll. Ent., Bureau of Science, Manila, P. I.

Hab: Palawan, Bacuit (*C. M. Weber,* Collector).

Die Form des Halsschildes, die pruinöse Oberseite und der aufgetriebene gelbe Bauch verweisen die Art in die *mucida*-Gruppe. Der Kopf ist kräftig, fast runzelig punktiert, der Clypeus in der Mitte leicht ausgebuchtet. Die Seiten des Halsschildes sind in der Mitte bogenförmig erweitert, vor den Vorderecken ist der Seitenrand flach ausgebuchtet. Die Oberfläche ist zerstreut mit Nabelpunkten bedeckt, doch stehen die Punkte nach den Seiten zu etwas dichter und sind gröber. Eine punktfreie Mittellinie ist nur in der hinteren Hälfte zu erkennen. Das Schildchen ist zerstreut punktiert, seine Mitte glatt. Die Flügeldecken sind mässig dicht nabelartig und namentlich beim ♀ etwas runzelig punktiert. In der Mitte neben der Naht zeigen sich beim ♀ Querfalten. Jede Flügeldecke lässt 4 schwache Rippen erkennen, von denen die innerste sich hinten sehr stark nach der Naht zu verbreitert. Während bei dem vorliegenden ♂ die ganze Oberseite der Flügeldecken pruinös ist, sind bei den beiden ♀ die Seiten glänzend. Das Pygidium ist schwach gewölbt

und mässig dicht mit Nabelpunkten bedeckt. Die Unterseite ist mit Ausnahme des gelben Abdomens braun, in der Mitte sehr zerstreut, an den Seiten dichter punktiert und hier behaart. Die behaarten Stellen an den Seiten des Abdomens sind matt. Die Vorderschienen sind in beiden Geschlechtern kräftig dreizähnig, die beiden ersten Glieder der Hintertarsen sind gleich lang. Die Krallen sind an der Basis verbreitert, am Ende ziemlich stark gebogen, der mittlere Zahn ist schwach und etwas nach rückwärts gerichtet.

**Protaetia banksi** sp. nov.

Viridis, flavo-maculata, supra opaca, subtus nitida. Capite maris subtiliter, feminae grosse punctato, fronte 2- an 4-flavo-maculata, clypeo nitido, marginibus paulo elevatis, margine antico emarginato; prothorace lateribus flavo-marginatis, vitta marginali postice abbreviata, disco flavo-bimaculato; scutello immaculato; elytris obsolete punctato-striatis, juxta scutelli basin atque apicem, prope suturam, apice, juxta margines laterales et inter scutellum et humerum maculis flavis ornatis; pygidio flavo-bivittato, vittis antice furcatis. Subtus pectoris abdominisque lateribus flavo-maculatis; processu mesosternali dilatato, margine antico rotundato; tibiis anticis in utroque sexu tridentatis, mediis et posticis intus flavo-ciliatis.

Long. 17 mill.

Typus No. 6334 in Coll. Ent. Bureau of Science, Manila, P. I.

Hab: Negros Occidental, Bago (*Charles S. Banks,* Collector).

Die Art hat in der Zeichnung Ähnlichkeit mit *venerabilis* Mohn. Sie ist etwas kleiner, die Unterseite ist bei allen vorliegenden Exemplaren grün und auf den Flügeldecken befindet sich unterhalb der Schulter eine schmale gelbe Seitenrandbinde, die bei *venerabilis* fehlt. Auch der Forceps ist anders gebildet wie bei dieser Art. Der Clypeus ist beim ♂ fein, beim ♀ kräftig punktiert, mässig hoch umrandet, der Vorderrand ausgebuchtet. Auf der Stirn befinden sich 2 oder 4 gelbliche Tomentflecken. Das Halsschild lässt infolge der Tomentbekleidung eine Skulptur nicht erkennen. Die Seitenränder sind gelb gesäumt, doch reicht die Seitenrandbinde nicht bis zu den Hinterecken. Auf dem Discus befinden sich 2 rundliche gelbe Makeln. Das Schildchen ist unpunktiert und ungefleckt. Die Schulterblätter haben einen hinteren gelben Rand. Die Flügeldecken lassen nur undeutliche Punktreihen erkennen. Sie sind neben der Naht etwas verflacht, so dass die Naht deutlich hervortritt. Von gelblicheln Makeln befinden sich auf ihnen je einer neben Schildchenbasis und Schildchenspitze, ein rundlicher in der Mitte und ein querer hinter der Mitte neben der Naht, ein kleiner an der Nahtspitze. Neben dem Seitenrande läuft eine schmale Längsbinde unterhalb der Schulter und befinden sich dahinter 4 mehr oder weniger quere Makeln, von denen der letzte neben dem Endbuckel liegt. Ausserdem befinden sich hinter dem Vorderrande noch 2 kleine, hintereinander-

liegende Flecken. Das Pygidium trägt jederseits eine gelbliche Längsbinde, welche sich nach vorn verbreitert und gabelt. Auf der Unterseite sind die Seiten von Brust und Abdomen gelb gemakelt und zwar trägt jedes Abdominalsegment jederseits 2 gelbe Querbinden, die äussere am Hinterrande, die innere am Vorderrande. Der Brustfortsatz ist nach vorn verbreitert, sein Vorderrand ist flach abgerundet, seine Oberfläche fast glatt. Die Vorderschienen sind in beiden Geschlechtern dreizähnig, die Vorderhüften, Schenkel und Schienen sind gelb bewimpert.

Ich widme die Art dem Entdecker derselben, Herrn Charles S. Banks, Entomologist, Bureau of Science in Manila.

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(New names are printed in **heavy-faced** type; numbers in *italics* indicate synonyms or references of minor importance.)


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